NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8900.557

National Policy

Effective Date:
8/11/20

Cancellation Date:
8/11/21

SUBJ: Revised FAA-Approved Deicing Program Updates, Winter 2020-2021

1. Purpose of This Notice. This notice provides inspectors with information on holdover times (HOT) and recommendations on various other ground deicing/anti-icing issues. This notice clarifies guidance regarding reported Aviation Routine Weather Report (METAR) obscurations to remove potential misinterpretations.

> **Note:** This notice is designed to be used in conjunction with the Federal Aviation Administration (FAA) Holdover Time Guidelines for Winter 2020-2021. The two documents complement each other and should be used together for a thorough understanding of the subject matter.

2. Audience. The primary audience for this notice is the Flight Standards Safety Assurance offices' Principal Operations Inspectors (POI) responsible for approving an air carrier's deicing program. The secondary audience includes air carriers and operators as well as the Safety Standards and Foundational Business offices.

3. Where You Can Find This Notice. You can find this notice on the MyFAA employee website at https://employees.faa.gov/tools_resources/orders_notices. Inspectors can access this notice through the Flight Standards Information Management System (FSIMS) at https://fsims.avs.faa.gov. Operators can find this notice on the FAA's website at https://fsims.faa.gov. This notice is available to the public at https://www.faa.gov/regulations_policies/orders_notices.

> **Note:** The FAA Holdover Time Guidelines for Winter 2020-2021 and related tables referenced in this document can be found on the Air Transportation Division's (AFS-200) Aircraft Ground Deicing website at https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/deicing.

4. Cancellation. This notice cancels Notice N 8900.525, Revised FAA-Approved Deicing Program Updates, Winter 2019-2020, dated October 7, 2019.

5. Background. Title 14 of the Code of Federal Regulations (14 CFR) part 121, § 121.629(c) requires that part 121 certificate holders have an approved ground deicing/anti-icing program. An alternative to complying with § 121.629(c) would be to comply with § 121.629(d). The current edition of Advisory Circular (AC) 120-60, Ground Deicing and Anti-Icing Program, provides guidance for obtaining approval of a ground deicing/anti-icing program and discusses the use of HOTs. Title 14 CFR part 125, § 125.221(b)(3) and part 135, § 135.227(b)(3) allow both kinds of certificate holders to comply with a part 121-approved program.

6. Changes (Additions, Updates, and Deletions).

a. New Content. Subparagraph 13a, Stopping and Starting the HOT Clock, has been added to clarify that the HOT clock cannot be stopped for intermittent precipitation.

b. Revised Content.

(1) Paragraph 15, Activity Recording (AR) Input, has been updated to reflect new recording procedures using Safety Assurance System (SAS) Activity Recording (AR).

(2) Paragraph 16, SAS Surveillance Requirement, has been updated to address the use of SAS Data Collection Tools (DCT) and additional surveillance.

c. Deleted Content. No significant deletions have been made.

7. Fluid Characteristics, Associated HOTs, and Other Related Information. FAA-approved guidelines for the application of deicing/anti-icing fluids are contained in the FAA HOT Guidelines.

a. Type I Fluid Characteristics. Type I fluids are Newtonian, nonthickened fluids used primarily for deicing, but may also be used for anti-icing with associated HOTs. They are thin in appearance, and, if colored, orange. Newtonian fluids tend to flow regardless of the forces acting on them, as evidenced by these fluids readily flowing off nonmoving aircraft surfaces.

(1) Type I Guidelines. The Type I HOT table is divided into two tables in the FAA HOT Guidelines:

- Table 2, Holdover Times for SAE Type I Fluid on Critical Aircraft Surfaces Composed Predominantly of Aluminum; and
- Table 3, Holdover Times for SAE Type I Fluid on Critical Aircraft Surfaces Composed Predominantly of Composites.

Note: The Type I fluid HOTs for aluminum surfaces (HOT Table 2) also apply to other metals used in aircraft construction, such as titanium. The Type I fluid HOTs for composite surfaces (HOT Table 3) must be applied to aircraft with all critical surfaces that are predominantly or entirely constructed of composite materials. However, the Type I fluid HOTs for composite surfaces do not need to be applied to aircraft that are currently in service, have a demonstrated safe operating history using Type I fluid aluminum structure HOTs, and have critical surfaces only partially constructed of composite material. If there is any doubt, consult with the aircraft manufacturer to determine whether aluminum or composite HOTs are appropriate for the specific aircraft.

(a) Type I fluid dilutes rapidly under precipitation conditions; however, the heat absorbed by aircraft surfaces will tend to keep the temperature of the diluted fluid above its freezing point for a limited time, which is considerably longer for metallic structures than for composite material structures, since composites do not transfer heat very efficiently. Within practical limits, the more heat an aircraft surface absorbs, the longer the surface temperature will remain above the freezing point of the fluid. Thus, the thermal characteristics of an aircraft's surface affect HOTs, with metallic structures serving as better heat conductors.

(b) Theoretically, when the temperature of the surface equals the freezing point of the fluid, the fluid is considered to have failed. Because structural mass varies throughout an aircraft with a corresponding variation in absorbed heat, the fluid will tend to fail first in:

- Structurally thin areas; and
- Areas with minimal substructure, such as trailing edges, leading edges, and wingtips.

Note: FAA Type I HOT guidelines are not approved for use with unheated Type I fluid mixtures.

(2) Effectiveness of Heated Type I Fluids. The heating requirements for Type I fluids are located in the FAA Type I fluid application table (refer to FAA HOT Guidelines, Table 47, Guidelines for the Application of SAE Type I Fluid).

(a) As previously stated, Type I HOTs are heavily dependent on the heating of aircraft surfaces. Unlike Types II, III, and IV fluids, which contain thickeners to keep these fluids on aircraft surfaces, Type I fluids are not thickened and flow off relatively soon after application; therefore, the heating of aircraft surfaces during the Type I fluid deicing and anti-icing process contributes to the HOT by elevating the surface temperature above the freezing point of the residual fluid.

(b) When establishing compliance with the temperature requirement of 60 °C (140 °F) at the nozzle, as stated in Table 47, the FAA does not intend for air carriers or deicing operators to continually measure the fluid temperature at the nozzle. The FAA deems that establishing the temperature drop (at typical anti-icing fluid application flow rates) between the last temperature-monitored point in the plumbing chain and the nozzle is sufficient. Manufacturers of ground vehicle-based deicing equipment have indicated a temperature drop of 10 °C (18 °F) or less. Some manufacturers producing equipment using instant-on heat or last bypass heaters have indicated a temperature drop of 5 °C (9 °F) or less. Ensuring that the drop in fluid temperature from the last measured point in the plumbing chain to the nozzle does not result in a fluid temperature of less than 60 °C (140 °F) at the nozzle is sufficient.

(3) Freezing Point of Type I Fluids. There is a note under the Type I HOT tables (Tables 2 and 3) that reads, "...freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature." The difference between the freezing point of the fluid and the outside air temperature (OAT) is known as the temperature or freezing point buffer. In this case, the buffer is 10 °C (18 °F), which you can interpret as the freezing point of the fluid being 10 °C (18 °F) below the OAT. The 10 °C (18 °F) temperature buffer is used to accommodate

inaccuracies and impreciseness in determining the many variables that affect the freezing point of a fluid mixture. Some of these variables include:

- OAT measurements.
- Refractometer freezing point measurements.
- Temperature of applied fluid/water mixture.
- Inaccuracies in freezing point depressant (FPD) fluid/water mixtures volumes.
- Differences between OAT and aircraft surface temperatures.
- Changes in OAT following fluid application.
- Differences in aircraft surface materials.
- Evaporation from repeated heating.
- Contamination from snow or rain entering the storage vessel.
- Wind effects.
- Solar radiation.

Note: For example, if the OAT is -3 °C (27 °F), the freezing point of the Type I fluid mixture should be -13 °C (9 °F) or lower, and the mixture applied at a minimum temperature of 60 °C (140 °F) at the nozzle before the HOT guidelines information in Tables 2 and 3 can be used.

b. Types II, III, and IV Fluids Characteristics. Types II, III, and IV fluids are thickened, non-Newtonian fluids. A non-Newtonian fluid is one whereby the viscosity (thickness) decreases when a shearing force is applied, such as the airflow over aircraft surfaces on takeoff. When applied to aircraft surfaces, these fluids form an anti-icing thickness layer, which absorbs freezing or frozen contamination with the exception of ice pellets and small hail. Although thickened, Type III fluid is much thinner than Type II or IV fluids, a characteristic making it suitable for lower rotation speed aircraft, as well as those with sufficient rotation speeds to use Type II or IV fluids.

(1) HOTs for Types II, III, and IV fluids are primarily a function of the OAT, precipitation type and intensity, and percent fluid concentration applied. The icing precipitation condition (e.g., frost, freezing fog, snow, freezing drizzle, light freezing rain, and rain on a cold-soaked wing) applies solely to active meteorological conditions.

(2) For Types II, III, and IV fluids, the fluid concentration (percent mixture) is the amount of undiluted (neat) fluid in water. Therefore, a 75/25 mixture is 75 percent FPD fluid and 25 percent water.

(3) Most FPD fluids are ethylene glycol-based or propylene glycol-based. Under precipitation conditions, chemical additives improve the performance of Types II, III, and IV fluids when used for anti-icing. These additives thicken and provide the fluid with non-Newtonian flow characteristics. Thickening enhances fluid HOT performance, and the non-Newtonian behavior results in fluid viscosity rapidly decreasing during the takeoff roll, which allows the fluid to flow off the critical wing surfaces prior to liftoff. This same characteristic makes Types II and IV fluids sensitive to viscosity degradation via shearing when being pumped or sprayed. Type III fluid is less sensitive, as it has a much lower viscosity.

(4) Tables dealing with Types II and IV fluids have a footnote that states, “No holdover time guidelines exist for this condition below -10 °C (14 °F).” This statement informs the user that, although the temperature range is below -8 °C (18 °F) to -14 °C (7 °F), the FAA does not consider HOT values valid below -10 °C (14 °F) for freezing drizzle and light freezing rain. These conditions usually do not occur at temperatures below -10 °C (14 °F).

(5) Longer HOTs for 75/25 Dilutions. For some fluids in some conditions, HOT increases when fluid concentration is reduced. This counter-intuitive phenomenon, which occurs rarely, happens when certain quantities of water added to fluids results in an increase in fluid viscosity and an enhancement in HOT performance (up to a certain point). Without knowing about this phenomenon, an operator may think that the data presented in the related HOT table is in error.

(6) HOTs for Nonstandard Dilutions of Types II, III, and IV Fluids. When Type II, III, or IV fluids are diluted to other than the standard published 100/0, 75/25, or 50/50 dilutions, the more conservative HOT and lowest operational use temperature (LOUT) associated with either the dilution above or below the selected dilution are applicable. For example:

- The HOT and LOUT of an 80/20 dilution would be the more conservative HOT and LOUT of either the 100/0 or 75/25 dilutions.
- The HOT and LOUT of a 60/40 dilution would be the more conservative HOT and LOUT of either the 75/25 or 50/50 dilutions.

(7) During the application of heated Types II and IV fluids in the one-step procedure, questions have arisen regarding the anticipated HOT performance of these fluids.

(a) In prior advisory information, the FAA indicated that maximum anti-icing effectiveness could be achieved from the application of unheated (cold) Type II fluids to deiced aircraft surfaces. This was based upon observations of the performance of Type II fluids in production at that time. The rationale was that a cold, unheated fluid would produce a thicker protective layer on aircraft surfaces, thus providing longer protection than a heated fluid presumably applied in a thinner layer.

(b) During tests conducted by APS Aviation Inc. of Montreal, Canada for the FAA and Transport Canada (TC) using the existing test protocol, HOT performance of heated 60 °C (140 °F) Types II and IV fluids was found to equal or exceed the HOT performance of unheated Types II and IV fluids for the same fluid concentrations, temperatures, and precipitation conditions. Therefore, these and other test results have indicated that there is no basis for reducing the current HOT guideline values for Types II and IV fluids or using the Type I fluid HOT guidelines when heated Types II and IV fluids are properly applied.

(8) Generic and Minimum HOT Values. The FAA Type II generic HOT guidelines (refer to FAA HOT Guidelines, Table 4, Generic Holdover Times for SAE Type II Fluids) and Type IV generic HOT guidelines (refer to FAA HOT Guidelines, Table 19, Generic Holdover Times for SAE Type IV Fluids) comprise the generic HOT values that are derived from the minimum (worst case) HOT values for all fluids for a specific precipitation condition, precipitation rate, temperature range, and fluid mixture concentration. An analysis of all

available Type II fluids is done annually to determine the Type II generic HOTs. A separate analysis of all available Type IV fluids is done annually to determine the Type IV generic HOTs. Air carriers may only use the fluid-specific HOT guidelines (refer to FAA HOT Guidelines, Tables 5 through 18 and Tables 20 through 39) when these specific fluids are used during the anti-icing process. If a carrier cannot positively determine which specific Type II or IV fluid was used, it must use the generic HOTs from Table 4 or Table 19, as appropriate.

Note: The lowest on-wing viscosity (LOWV) of the fluid being used must always be respected, even when the generic Type II or IV HOTs are used.

Note: When flaps and/or slats are extended to the takeoff configuration prior to anti-icing fluid application and remain in that configuration while taxiing to takeoff, the adjusted HOT tables must be used. This includes the Type II (Table ADJ-4, Adjusted Generic Holdover Times for SAE Type II Fluids) and Type IV (Table ADJ-19, Adjusted Generic Holdover Times for SAE Type IV Fluids) generic tables. (Also see subparagraph 13c.)

c. Differences Between Type I and Types II, III, and IV Fluids HOT Guidelines Usage.

(1) A percent fluid concentration column appears in all tables dealing with Types II, III, and IV fluids, but not tables dealing with Type I fluids because:

- Type I fluids are applied to maintain at least a 10 °C (18 °F) buffer between the OAT and the freezing point of the fluid/water mix.
- Types II, III, and IV fluids are used in concentrations of 100/0, 75/25, or 50/50 in the anti-icing application. The freezing point buffer for these fluids will be at least 7 °C (13 °F) when used according to the dilutions and temperatures shown on their corresponding HOT tables.

Note: HOT tests are conducted using the 10 °C (18 °F) buffer for Type I fluids and the appropriate fluid/water concentration (100/0, 75/25, or 50/50) for Types II, III, and IV fluids to maintain a minimum 7 °C (13 °F) buffer.

(2) The HOT for a Type I fluid is considerably less than that for Type II, III, or IV fluids. The amount of heat absorbed by aircraft surfaces during the deicing/anti-icing operations heavily influences the degree of protection provided by Type I fluid. To use the Type I HOT guidelines, the fluid must be applied heated to deiced surfaces with a minimum temperature of 60 °C (140 °F) at the nozzle and applied at a rate of at least 1 liter per square meter (approximately 2 gallons per 100 square feet). Since composite surfaces conduct heat poorly, the composite surfaces HOTs are shorter.

(3) Although Type I fluids are normally considered deicing fluids and Types II, III, and IV fluids are considered anti-icing fluids, all types have been used as both deicing and anti-icing agents. However, the performance of Type I fluid when used as an anti-icing agent is inferior to that of Types II, III, and IV fluids. Also, heated and diluted Types II and IV fluids are being used for deicing and anti-icing operations. This is a common practice among many of the European airlines and in use at some foreign airports by U.S. air carriers.

Note: The use of HOT guidelines is associated with anti-icing procedures and does not apply to deicing.

d. LOUT.

(1) At colder temperatures, deicing/anti-icing fluids become too thick to flow off aircraft properly during takeoff and/or their freezing point temperature is reached and they are no longer able to keep aircraft surfaces from freezing in the presence of active precipitation. The LOUT is the lowest temperature at which a fluid has been determined to flow off aircraft critical surfaces in an aerodynamically acceptable manner while maintaining the required freezing point buffer.

(a) The freezing point buffer is 7 °C (13 °F) below OAT for SAE Types II, III, and IV fluids and 10 °C (18 °F) below OAT for SAE Type I fluids.

(b) There are two aerodynamic fluid flow-off test protocols: the high speed test for aircraft with rotation speeds generally greater than 100 knots (kts) and the low speed test for aircraft with rotation speeds generally less than 100 kts. Types II and IV fluids typically do not pass the low speed test. Therefore, in order for these fluids to be used on a low rotation speed aircraft, the aircraft manufacturer must conduct testing to determine if these fluids can be safely applied on these aircraft and to identify operational procedures that must be implemented to ensure safe operation when these fluids have been applied.

(2) Following are three examples to illustrate how LOUTs are determined:

- **Example A:** A specific Type IV fluid is aerodynamically acceptable down to -33 °C (-27 °F) and has a freezing point of -36 °C (-33 °F). Once the 7 °C (13 °F) freezing point buffer is factored in, the limiting factor is the freezing point, resulting in an LOUT of -29 °C (-20 °F).
- **Example B:** A specific Type I fluid is aerodynamically acceptable down to -30 °C (-22 °F) and has a freezing point of -35 °C (-31 °F). Once the 10 °C (18 °F) freezing point buffer is factored in, the limiting factor is the freezing point, resulting in an LOUT of -25 °C (-13 °F).
- **Example C:** A specific Type I fluid is aerodynamically acceptable down to -30 °C (-22 °F) and has a freezing point of -42 °C (-44 °F). Since the 10 °C (18 °F) freezing point buffer requirement is met at -32 °C (-26 °F), the limiting factor is the aerodynamic performance, resulting in an LOUT of -30 °C (-22 °F).

(3) LOUT information is provided for each Type I, II, III, and IV fluid in the FAA HOT Guidelines document (refer to Tables 43 through 46, Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance). This information is derived by the FAA based on data provided by the fluid manufacturers. Contact the fluid manufacturer if further clarification with respect to the information in these tables is required.

(a) LOUTs for Type I fluids include the manufacturer-specified fluid/water concentration used to establish the LOUT for each fluid. This concentration should not be exceeded.

(b) There can be multiple LOUTs provided for Types II, III, and IV fluids to account for the undiluted fluid (100/0) and the 75/25 and 50/50 dilutions.

e. General. The FAA emphasizes that air carriers should read and understand all notes and cautions in the FAA HOT Guidelines document, such as the reference to the 10 °C (18 °F) buffer for Type I fluids to preclude improper usage of fluids.

8. Precipitation Intensity, Types, and Other Related Information.

a. Precipitation Intensity. In all cells of the HOT tables where two values of time are provided (except for light and very light snow, freezing drizzle, and freezing rain), the precipitation intensity is light to moderate. For the "Very Light" and "Light" snow columns, HOTs should be considered in terms of their respective rates. Very light snow has a liquid equivalent snowfall rate of 0.3 to 0.4 millimeters per hour (mm/h), and light snow has a rate of 0.4 to 1.0 mm/h. (For reference, moderate snow has a liquid equivalent rate of 1.0 to 2.5 mm/h, and heavy snow is greater than 2.5 mm/h.) The longer times for very light snow would correspond to the lesser rate, whereas the shorter times would correspond to higher rates. For freezing rain, the range is confined to light freezing rain, which can be up to 2.5 mm/h. Except for freezing drizzle, heavy precipitation conditions are not considered in any HOT guidelines.

Note: The FAA does not approve takeoff in conditions of moderate or heavy freezing rain, heavy ice pellets, and hail. The FAA has developed allowance times and associated limitations for takeoff in light or moderate ice pellets, light ice pellets mixed with other forms of precipitation, and small hail, as listed in the ice pellet and small hail allowance times tables (refer to FAA HOT Guidelines, Table 40, Allowance Times for SAE Type III Fluids, and Table 41, Allowance Times for SAE Type IV Fluids). Additionally, takeoff in heavy snow may be accomplished if the requirements for operating in this condition, described in subparagraph 8d, are met.

Note: In addition to following the operations in heavy snow guidance in the FAA HOT Guidelines, the FAA Engine and Propeller Standards Branch (AIR-6A0) has issued the following statement: "Turbine engine power run-up procedures are defined in the Aircraft Flight Manual (AFM)." AIR-6A0 recommends that operators consider performing more frequent engine power run-ups when operating in heavy snow conditions.

(1) Example. In Table 2 of the FAA HOT Guidelines, under the "Outside Air Temperature" column, below -3 °C to -6 °C for freezing drizzle, the HOT is 0:05 to 0:09, which is interpreted as a HOT from 0 hours, 5 minutes to 0 hours, 9 minutes. Depending on the freezing drizzle intensity, the approximate time of protection expected could be:

- As short as 5 minutes for a moderate or heavy freezing drizzle intensity, or
- As long as 9 minutes for light freezing drizzle conditions.

(2) Snow Conditions.

(a) The Types I, III, and IV, and most Type II fluid-specific HOT guidelines include three separate snow columns representing very light snow, light snow, and moderate snow conditions. Recent surveys and analysis of worldwide snow conditions have revealed that more than 75 percent of snow occurrences fall into the light and very light snow category. Values in the “Very Light,” “Light,” and “Moderate” snow columns are based on tests conducted by APS Aviation Inc. These tests were conducted on behalf of the FAA and TC.

(b) HOT values for liquid equivalent snowfall rates between 0.4 and 1 mm/h (0.02 and 0.04 inches per hour (in/h), and 4 and 10 grams per square decimeter per hour ($g/dm^2/h$)) are selected for the “Light” snow column and HOT values for liquid equivalent snowfall rates between 0.3 and 0.4 mm/h (0.01 and 0.02 in/h, and 3 and 4 $g/dm^2/h$) are selected for the “Very Light” snow column. Overall, these selections were based upon a number of factors, including:

- Snow intensity reporting and measurement inaccuracies for light conditions of less than 0.5 mm/h.
- Potential wind effects.
- Light snow variability.
- Possible safety concerns associated with pretakeoff checks.

(3) Frost Conditions. Only one HOT value is provided in each cell of the FAA frost HOT table (refer to FAA HOT Guidelines, Table 1, Active Frost Holdover Times for SAE Type I, Type II, Type III, and Type IV Fluids). Frost intensities or accumulations are low in comparison to other precipitation conditions and decrease at colder temperatures. This usually results in HOTs for frost being considerably longer in comparison to HOTs for other precipitation conditions. The longer HOTs should accommodate most aircraft ground operational requirements.

b. Frost. Frost occurs frequently during winter operating conditions. Frost due to radiation cooling is a uniform thin, white deposit of fine crystalline texture, which forms on exposed surfaces that are below freezing, generally on calm, cloudless nights where the air at the surface is close to saturation. When the deposit is thin enough for surface features underneath, such as paint lines, markings, and lettering, to be distinguished, it is often referred to as hoar frost. Frost can also form on the upper or lower surfaces of the wing due to cold-soaked fuel.

(1) Frost Characteristics. Frost has the appearance of being a minor contaminant and does not display the same obvious danger signal as do other types of contamination, such as snow or ice. However, frost is a serious threat to the safety of aircraft operations because it always adheres to the aircraft surface, is rough, and causes significant lift degradation and increased drag.

(2) Frost Formation. Frost forms whenever the exposed surface temperature cools below the OAT to or below the frost point (not the dewpoint).

(3) Active Frost. Active frost is a condition when frost is forming. During active frost conditions, frost will form on an unprotected surface or re-form on a surface protected with anti-icing fluid where the HOT has expired. If the exposed surface temperature is equal to or below the frost point, frost will begin to accrete on the surface. Once formed, residual accreted frost may remain after the active frost phase if the exposed surface temperature remains below freezing.

(4) Dewpoint and Frost Point. The dewpoint is the temperature at a given atmospheric pressure to which air must be cooled to cause saturation. The dewpoint can occur below or above 0 °C (32 °F). The frost point is the temperature, at or below 0 °C (32 °F), at which moisture in the air will undergo deposition as a layer of frost on an exposed surface. The frost point occurs between the OAT and the dewpoint. METAR does not report frost point; however, it does report dewpoint. The frost point is higher (warmer) than the dewpoint for a given humidity level in the air. The frost point and the dewpoint are the same at 0 °C; at a dewpoint of -40 °C, the frost point is 3.2 °C warmer (-36.8 °C). The following table provides further examples of the correlation between dewpoint and frost point.

Dewpoint Temperature (°C)	Frost Point Temperature (°C)
0	0
-5	-4.4
-10	-8.9
-15	-13.5
-20	-18.0
-25	-22.7
-30	-27.3
-35	-32.1
-40	-36.8

(5) Frost HOTs. Frost HOTs are for active frost conditions in which frost is forming. This phenomenon occurs when aircraft surfaces are at or below 0 °C (32 °F) and at or below the frost point. Frost typically forms on cold nights with clear skies.

Note: Changes in OAT over the course of longer frost HOTs can be up to 10 °C (18 °F) or more; therefore, the pilot should shorten the HOT based on decreases in OAT that may have occurred following the deicing/anti-icing treatment. Changes in OAT over the course of longer frost HOTs can be significant; the appropriate HOT to use is the HOT provided for the coldest OAT that has occurred in the time between the deicing/anti-icing fluid application and takeoff.

c. Freezing Fog. The freezing fog condition is best confirmed by observation. If there is accumulation in the deicing area, then the condition is active and freezing fog accumulation will tend to increase with increasing wind speed. The least accumulation occurs with zero wind. The measured deposition rate of freezing fog at 1 and 2.5 meters per second (m/s) wind speeds are 0.2 and 0.5 mm/h (2 and 5 $g/dm^2/h$), respectively. Higher accumulations are possible with higher wind speeds. Freezing fog can accumulate on aircraft surfaces during taxi since taxi speed has a similar effect as wind speed.

d. Operations in Heavy Snow.

(1) Tactile and Visual Checks of Aircraft. No HOTs exist for heavy snow conditions in the current HOT tables. Review of existing data from past testing has indicated takeoffs may be safely conducted with proper tactile and/or visual checks, as appropriate for the aircraft, and a determination that the fluid has not failed. A tactile and/or visual check in heavy snow conditions must be accomplished in a manner that provides an assessment that can be accurately accomplished. It is imperative that the tactile and/or visual check procedures to determine if the anti-icing fluid has failed in heavy snow conditions be at least as comprehensive as the authorized procedures for the operator's pretakeoff contamination check (when HOTs have been exceeded) for those precipitation conditions for which HOTs exist. Anti-icing fluids dissolve the snow and absorb the resulting moisture into the fluid. When the fluid begins to fail, it starts to change in appearance (e.g., less glossy and more opaque) and the snow starts to accumulate on and in the fluid. At this stage, the fluid has failed and takeoff is not authorized. If the operator's procedure to accomplish this check is different from the operator's approved pretakeoff contamination check procedures for other precipitation conditions, this check procedure must be verified and approved by the operator's POI.

(2) Takeoff in Heavy Snow Conditions. Operators with a deicing program approved in accordance with § 121.629 will be allowed to takeoff in heavy snow conditions subject to the following restrictions:

(a) The aircraft must be anti-iced with undiluted Type II, III, or IV fluids.

(b) The aircraft critical surfaces must be free of contaminants, or the aircraft must be properly deiced before the application of the anti-icing fluid.

(c) The operator must accomplish a visual check and, if required for the specific aircraft type, a tactile check of the aircraft critical surfaces within 5 minutes of takeoff.

Note: If this check is accomplished visually from within the aircraft, the view must be such that it is not obscured by deicing/anti-icing fluid, dirt, or fogging. If the critical surfaces cannot be seen due to snowfall, distance from the viewing position, inadequate lighting, or for any other reason, the check must be a visual or tactile check conducted from outside the aircraft.

(d) If a definitive fluid failure determination cannot be made using the checks prescribed, takeoff is not authorized. The aircraft must be completely deiced, and if precipitation is still present, anti-iced again before a subsequent takeoff.

Note: Current aircraft certification standards only require testing of flight instrument sensing devices and engine anti-icing systems in moderate snow levels. Ground operations in heavy snow conditions may exceed the capabilities or limitations of these systems and devices to adequately provide anti-icing.

e. Operations in Ice Pellet and Small Hail Conditions.

(1) HOTs vs. Allowance Times.

(a) HOTs are developed using testing protocols described in SAE Aerospace Recommended Practices (ARP) 5485, Endurance Time Test Procedures for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluids; and ARP5945, Endurance Time Test Procedures for SAE Type I Aircraft Deicing/Anti-Icing Fluids. These protocols rely predominantly on the visual inspection of test surfaces to determine fluid failure, which occurs when the fluid is no longer able to absorb actively occurring frozen or freezing precipitation (e.g., snow and freezing drizzle). HOTs are applicable to most forms of precipitation with the exception of ice pellets. Due to their physical characteristics, ice pellets tend to become partially embedded in fluids and can take longer to melt compared to snow or other forms of precipitation. For this reason, the visual indicators conventionally used in developing HOTs cannot be applied to ice pellets.

(b) As a means to address ice pellet precipitation, a test protocol was developed that uses a combination of aerodynamic fluid flow-off performance of ice pellet-contaminated fluids in combination with visual inspection and evaluation of a wing model test surface. Since 2005, guidance has been derived from this testing protocol and is known as "allowance times." This guidance is also applicable to small hail due to inherent similarities to ice pellets.

(c) Operationally, both HOTs and allowance times provide the times for an aircraft to safely depart following proper deicing/anti-icing. The main difference between the two is the applicability of the pretakeoff contamination check to HOTs, which cannot be used with allowance times. The only scenario for which an allowance time can be extended is if the precipitation stops and does not restart while still within the allowance time and the allowable 90-minute extension time.

(2) Operations Guidance.

(a) Tests have shown that ice pellets generally remain in the frozen state embedded in Types III and IV anti-icing fluid, and are not absorbed and dissolved by the fluid in the same manner as other forms of precipitation. Using current guidelines for determining anti-icing fluid failure, the presence of a contaminant not absorbed by the fluid (remaining embedded) would be an indication that the fluid has failed. These embedded ice pellets are generally not readily detectable by the human eye during pretakeoff contamination check procedures. Therefore, a visual pretakeoff contamination check in ice pellet conditions may not be of value and is not required.

(b) The research data has also shown that after proper deicing and anti-icing, the accumulation of light ice pellets, moderate ice pellets, and ice pellets mixed with other forms of precipitation in Types III and IV fluid will not prevent the fluid from flowing off the aerodynamic surfaces during takeoff. This flow-off, due to the shearing forces, occurs with rotation speeds consistent with Type III or IV anti-icing fluid recommended applications, and up to the applicable allowance time listed in the allowance time tables. These allowance times are from the start of the anti-icing fluid application. Additionally, if the ice pellet condition stops, and the allowance time has not been exceeded, the operator is permitted to consider the anti-icing fluid effective without any further action up to 90 minutes after the start of the application time of the anti-icing fluid. To use this guidance in the following conditions, the OAT must remain constant or increase during the 90-minute period:

- Light ice pellets mixed with freezing drizzle,
- Light ice pellets mixed with freezing rain, and
- Light ice pellets mixed with rain.

Examples:

1. Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0 °C, light ice pellets fall until 10:20 and stop and do not restart. The allowance time stops at 10:50; however, provided that no precipitation restarts after the allowance time of 10:50, the aircraft may takeoff without any further action up to 11:30.

2. Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0 °C, light ice pellets mixed with freezing drizzle fall until 10:10 and stop and restart at 10:15 and stop at 10:20. The allowance time stops at 10:25; however, provided that the OAT remains constant or increases and that no precipitation restarts after the allowance time of 10:25, the aircraft may takeoff without any further action up to 11:30.

3. Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0 °C, light ice pellets mixed with freezing drizzle fall until 10:10 and stop and restart at 10:30 with the allowance time stopping at 10:25, the aircraft may not takeoff, no matter how short the time or type of precipitation, after 10:25 without being deiced and anti-iced if precipitation is present.

(c) Operators with a deicing program updated to include the allowance time information contained herein will be allowed, in the specified ice pellet and small hail conditions listed in Tables 40 and 41, up to the specific allowance time, to commence the takeoff with the following restrictions:

1. The aircraft critical surfaces must be free of contaminants before applying anti-icing fluid. If not, the aircraft must be properly deiced and checked to be free of contaminants before the application of anti-icing fluid.

2. The allowance time is valid only if the aircraft is anti-iced with undiluted Type III or IV fluid.

3. The Type III allowance times are only applicable for unheated anti-icing fluid applications.

4. Due to the shearing qualities of Types III and IV fluids with embedded ice pellets, allowance times are limited to aircraft with a rotation speed of 100 kts or greater or 115 kts or greater, as indicated in the allowance time tables.

5. If the takeoff is not accomplished within the applicable allowance time, the aircraft must be completely deiced, and if precipitation is still present, anti-iced again prior to a subsequent takeoff. If the precipitation stops at or before the time limits of the applicable allowance time and does not restart, the aircraft may takeoff up to 90 minutes after the start of the application of the Type III or IV anti-icing fluid, subject to the restrictions in subparagraph 8e(2)(b).

6. A pretakeoff contamination check is not required. The allowance time cannot be extended by an internal or external check of the aircraft critical surfaces.

7. If ice pellet precipitation becomes heavier than moderate or if the light ice pellets mixed with other forms of allowable precipitation exceeds the listed intensities or temperature range, the allowance time cannot be used.

8. If the temperature decreases below the temperature on which the allowance time was based, and:

- The new lower temperature has an associated allowance time for the precipitation condition and the present time is within the new allowance time, then that new time must be used as the allowance time limit.
- The allowance time has expired (within the 90-minute post-anti-icing window if the precipitation has stopped within the allowance time), the aircraft may not takeoff and must be completely deiced and, if applicable, anti-iced before a subsequent takeoff.

9. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used (e.g., if light small hail is reported, the light ice pellets allowance times can be used). This also applies in mixed conditions (e.g., if light small hail mixed with snow is reported, use the light ice pellets mixed with snow allowance times).

f. Hail, Small Hail, Ice Pellets, Snow Grains, and Snow Pellets (METAR Codes GR, PL, SG, GS, and SHGS).

(1) Hail, small hail, ice pellets, snow grains, and snow pellets are related winter precipitation types. When anti-icing fluids are used in these conditions, guidance on their performance is provided by: (a) snow HOTs, (b) ice pellet (and small hail) allowance times, or (c) neither (see Table 1, Holdover or Allowance Times for Hail, Small Hail, Ice Pellets, Snow Grains, and Snow Pellets).

Table 1. Holdover or Allowance Times for Hail, Small Hail, Ice Pellets, Snow Grains, and Snow Pellets

Weather Condition	Applicable Holdover Times/Allowance Times
Snow Pellets	Snow Holdover Times
Snow Grains	Snow Holdover Times
Ice Pellets	Ice Pellet (and Small Hail) Allowance Times
Small Hail	Ice Pellet (and Small Hail) Allowance Times
Hail	No Holdover Times or Allowance Times

(2) The way some of these precipitation types are reported by METAR varies by country. Different HOTs or allowance times may apply when the same METAR code is reported in different countries. Table 2, METAR Codes and Holdover or Allowance Times Used by Country, shows the appropriate HOTs or allowance times to be used with METAR codes GS, GR, PL, SHGS, and SG when they are reported in the United States, Canada, or a different country.

Table 2. METAR Codes and Holdover or Allowance Times Used by Country

UNITED STATES		
METAR Report	**Weather Condition**	**Applicable HOTs/Allowance Times**
SG	Snow Grains	Snow Holdover Times
GS	Snow Pellets	Snow Holdover Times
SHGS	Snow Pellets with Showers	Snow Holdover Times
PL	Ice Pellets	Ice Pellet (and Small Hail) Allowance Times
GR with remarks stating "less than 1/4"	Small Hail	Ice Pellet (and Small Hail) Allowance Times
GR with remarks stating "1/4 or greater"	Hail	No HOTs or Allowance Times
CANADA		
METAR Report	**Weather Condition**	**Applicable HOTs/Allowance Times**
SG	Snow Grains	Snow Holdover Times
GS	N/A (GS never reported in isolation)	N/A
SHGS without remarks	Snow Pellets with Showers	Snow Holdover Times
SHGS with remarks stating diameter of hail	Small Hail	Ice Pellet (and Small Hail) Allowance Times
TSGS without remarks	Snow Pellets with a Thunderstorm	Snow Holdover Times
TSGS with remarks stating diameter of hail	Small Hail with a Thunderstorm	Ice Pellet (and Small Hail) Allowance Times
PL	Ice Pellets	Ice Pellet (and Small Hail) Allowance Times
GR	Hail	No HOTs or Allowance Times
REST OF WORLD		
METAR Report	**Weather Condition**	**Applicable HOTs/Allowance Times**
SG	Snow Grains	Snow Holdover Times
GS or SHGS	Snow Pellets or Small Hail	Ice Pellet (and Small Hail) Allowance Times*
GR	Hail	No HOTs or Allowance Times
PL	Ice Pellets	Ice Pellet (and Small Hail) Allowance Times

* If additional information provided with the METAR makes it clear that the weather condition is snow pellets and not small hail, then snow HOTs can be used.

(3) While most countries, including the United States and Canada, do not report an intensity with small hail, some countries do (e.g., Japan). If no intensity code (+ or -) is reported with small hail, the intensity is assumed to be moderate and the moderate ice pellet allowance times apply. If an intensity code (+ or -) is reported with small hail, the intensity can be used to

determine the applicable allowance times. (Note that this logic also applies when small hail is reported mixed with another precipitation condition.) Examples are provided in Table 3.

Table 3. Examples of Small Hail Allowance Times by Reported Intensity

Weather Condition	Applicable Allowance Times	Examples	
		Weather Reported	**Applicable Allowance Times**
Small Hail reported without intensity	Moderate Ice Pellets (or Small Hail)	Small Hail, no intensity	Moderate Ice Pellets
		Small Hail mixed with Rain, no intensity	Moderate Ice Pellets mixed with Rain
Small Hail reported with light (-) intensity	Light Ice Pellets (or Small Hail)	Small Hail, light (-) intensity	Light Ice Pellets
		Small Hail, light (-) intensity, mixed with Rain	Light Ice Pellets mixed with Rain
Small Hail reported with heavy (+) intensity	No Allowance Times (No allowance times exist for heavy conditions.)		

g. Other Conditions For Which HOTs or Allowance Times Do Not Exist (Heavy Ice Pellets, Moderate and Heavy Freezing Rain, and Hail).

(1) General. HOTs and/or allowance times have not been established for heavy ice pellets, moderate and heavy freezing rain, and hail. Therefore, this notice does not provide HOTs or other forms of relief for dispatch in these conditions.

(2) Regulations. The regulations clearly state, "No person may take off an aircraft when frost, ice, or snow is adhering to the wings…" (refer to § 121.629(b)) and "…no person may dispatch, release, or take off an aircraft any time conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft…" (refer to § 121.629(c)). Under some conditions, the aircraft critical surfaces may be considered free of contaminants when a cold, dry aircraft has not had deicing and/or anti-icing fluids applied, and ice pellets/snow pellets are not adhering and are not expected to adhere to the aircraft critical surfaces. Refueling with fuel warmer than the wing skin temperature may create a condition whereby previously non-adhering contaminants may adhere to the wing surfaces.

h. Mixed Precipitation Conditions.

(1) Allowance times are provided for ice pellets mixed with several other precipitation types in the allowance time tables.

(2) A footnote in the HOT tables allows light freezing rain HOTs to be used in conditions of very light or light snow mixed with light rain.

(3) It should be noted that obscurations and descriptors do not count as unique precipitation types. Therefore, when they are reported in conjunction with a single precipitation type, this is not considered a mixed precipitation condition.

(a) Obscurations include mist, dust, fog, sand, smoke, haze, and volcanic ash.

Note: The FAA HOT Guidelines provide HOTs for the obscuration freezing fog.

(b) Descriptors include showers, blowing, shallow, patches, thunderstorm, partial, low drifting, and freezing.

Note: Typically HOTs are required for freezing and frozen precipitation, but not for non-freezing precipitation. The “Rain on Cold Soaked Wing” column represents a non-freezing precipitation condition.

(4) If non-freezing precipitation is reported below 0 °C, the flightcrew should determine if freezing precipitation is occurring. If it is, HOTs for the equivalent freezing precipitation type should be used.

9. Guidelines for Pilot Assessments of Precipitation Intensity Procedures.

a. Pilot Discretion. Pilots may act based on their own assessment of precipitation intensity only in those cases where the officially reported meteorological precipitation intensity is grossly different from that which is obviously occurring (e.g., precipitation is reported when there is no actual precipitation occurring). As always, if, in the pilot’s judgment, the intensity is greater, or a different form of precipitation exists than that being reported, then the appropriate course of action and applicable HOTs or allowance times for the higher intensity or different form of precipitation must be applied (e.g., if precipitation is being reported as light ice pellets and the pilot assessment is that it is moderate ice pellets, then the pilot must apply the allowance time for moderate ice pellets).

b. Reporting New Observation. Before a pilot takes action on his or her own precipitation intensity assessment, he or she will request that a new observation be taken. A pilot must not take action based on his or her own precipitation intensity assessment unless either a new observation is not taken and reported, or the new precipitation intensity officially reported remains grossly different from that which is obviously occurring.

c. Use of Company Coordination Procedures. The company’s approved deicing program, in accordance with § 121.629, must contain the required company coordination procedures for a pilot when he or she chooses to take actions that are based on his or her precipitation intensity assessment that is less than the precipitation intensity that is being officially reported (e.g., the official weather report is moderate freezing rain, and the pilot’s assessment is that there is no liquid precipitation; or the reported weather is moderate snow and ice pellets, and by the pilot’s assessment there is light snow and no ice pellets). These procedures require coordination with the company before the pilot takes such action, or if the approved company program allows, a report of action taken after the pilot has opted to exercise this option.

d. Pretakeoff Contamination Check. When a pilot acts based on his or her own assessment that precipitation intensity levels are lower than the official reported intensity level, a check at least as comprehensive as the operator's pretakeoff contamination check (when HOTs have been exceeded) per the approved procedure for the applicable aircraft is required within 5 minutes of beginning the takeoff.

> **Note:** Unlike other forms of precipitation, individual ice pellets may be seen, if viewed close up or felt, embedded in the fluid since they are not readily absorbed into the anti-icing fluid like other forms of precipitation. Under ice pellet conditions and within the appropriate allowance times, if ice pellets are visible, they should appear as individual pellets and not form a slushy consistency indicating fluid failure. This distinction is very difficult to make from inside the aircraft. If through an internal or external visual check or a tactile check (as appropriate for the aircraft) the ice pellets mixed with the anti-icing fluid form a slushy consistency or are adhering to the aircraft surface, then the intensity level that the pilot based the allowance time on was not accurate and the takeoff should not be conducted.

e. Permissible Use of Pilot Assessment of Precipitation Intensity. Under the following conditions, a pilot may act based on his or her own assessment of precipitation intensity levels that are less than that being officially reported. Pilot assessment of precipitation intensity levels may only be used when sufficient natural sunlight or artificial lighting is available to provide adequate exterior visibility. The snowfall intensity table provided in the FAA HOT Guidelines, Table 42, Snowfall Intensities as a Function of Prevailing Visibility, is based on prevailing visibility, and allowances are made in the table for the effects of night (darkness) conditions.

(1) Ice Pellets. When ice pellets are being reported, the following chart information extracted from the Federal Meteorological Handbook No. 1 (FMH-1), Surface Weather Observations and Reports, must be used to assess their actual intensity rate:

(a) Light—scattered pellets that do not completely cover an exposed surface regardless of duration.

(b) Moderate—slow accumulation on ground.

(c) Heavy—rapid accumulation on ground.

(2) Drizzle/Freezing Drizzle and Rain/Freezing Rain. The differentiations between these various conditions are based on droplet size and require careful observation. Therefore, when drizzle/freezing drizzle or rain/freezing rain is being reported, a pilot must use both visual and physical (feel) cues in determining the presence of precipitation. If precipitation is present to any degree by visual or physical cues, the official reported precipitation type and intensity must be used for determining the appropriate course of action and applicable HOTs. If the pilot determines no precipitation is present, the aircraft should be deiced, if necessary, and consideration given to treating the aircraft with anti-icing fluid as a precaution for encountering the reported precipitation on taxi-out. As always, if in the pilot's judgment the intensity is greater or a different form of precipitation exists than that being reported, then the appropriate course of

action and applicable HOTs or allowance times for the higher intensity or different form of precipitation must be applied.

(3) Snow. The snowfall visibility table, Table 42, is published in the annual FAA HOT Guidelines document for use in determining snow intensity rates based on prevailing visibility and must be used in place of official reported intensities. Thus, this table should be used for pilot assessment of snowfall intensity rates, unless snow and an obscuration (fog, smoke, haze, or any other obscuration) are reported. For simplification purposes, portions of the table may be included in an air carrier's winter operations plan in non-table format. An example would be: "Since very light snow is in the Type IV tables, and since the METAR and the associated ATIS do not report very light snow, a METAR-reported visibility of 2.5 miles or higher can be used as an indication that the snowfall intensity is very light." An air carrier certainly would also have the option of providing a more detailed description utilizing lower METAR-reported visibilities for specific day/night and temperature conditions.

Note: The use of Runway Visual Range (RVR) is not permitted for determining visibility used with the HOT tables.

Note: Some METARs contain tower visibility as well as surface visibility. Whenever surface visibility is available from an official source, such as a METAR, in either the main body of the METAR or in the Remarks ("RMK") section, the preferred action is to use the surface visibility value.

(4) Training Requirements. Pilots who are limited in their precipitation intensity assessments to determining whether or not precipitation is falling will only be required to have instruction on how that assessment should be made (e.g., how and where to perform the physical feel cues to determine if precipitation is present).

(a) Pilots who determine precipitation intensity will be required to be trained on their company's pilot precipitation intensity assessment procedures. These pilots will need training on the methods used by weather observers to determine precipitation types and intensities and on how to conduct their own assessment under the different precipitation conditions. The FMH-1 and Table 42 must be used as the source documents for this training.

(b) Additionally, § 121.629 requires anti-icing fluid failure recognition training under the various precipitation conditions for pilots and all other persons responsible for conducting pretakeoff contamination checks if anti-icing fluids are used.

10. Fluid Quality Control (QC). QC checks of all stored fluids should be performed before the start of the deicing season. At a minimum, the checks for all fluid types should include visual inspections of the fluid and the containers for contamination and separation, refractive index measurements, and pH measurements. All values must be within the limits recommended for the manufacturer's specific fluid type and brand.

a. Types II, III, and IV Fluids Viscosity Check. In addition, for Types II, III, and IV fluids, viscosity checks should be performed at the beginning of the icing season, periodically throughout the winter, and any time fluid contamination or damage is suspected or after major deicing truck pumping and spraying system maintenance. These checks should include samples obtained through the spray nozzles of application equipment. The checks must be conducted using one of the measurement methods (manufacturer method or SAE method Aerospace Standard (AS) 9968, Laboratory Viscosity Measurement of Thickened Aircraft Deicing/Anti-icing Fluids with the Brookfield LV Viscometer) provided for the specific fluid brand/product and dilution in Table 44, Type II Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance; Table 45, Type III Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance; or Table 46, Type IV Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance, which list fluids tested for anti-icing performance and aerodynamic acceptance. The viscosities obtained during these checks should be compared to the LOWV values provided in Table 44, 45, or 46; fluid samples with viscosities below the stated LOWV cannot be used with the HOT tables, as they may not provide the HOT protection stated in the tables. Viscosity measurement methods and values for dilutions of Types II, III, and IV fluids are included in the FAA HOT Guidelines to facilitate fluid viscosity checks in locations where thickened fluids are diluted before applying and, in some cases, may be stored diluted.

(1) Nozzle samples should be collected from suitable, clean surfaces, such as aluminum plates or plastic sheets laid on a flat surface, or the upper surface of an aircraft wing. The fluid should be sprayed in a similar manner as that used in an actual anti-icing operation. A small squeegee can be used to move the fluid to the edge of the sheet or wing so it can be collected in a clean, nonmetallic, wide-mouthed sample bottle.

(2) Nozzle samples may also be sprayed into clean containers, such as a large trash can or containers with clean plastic liners, such as trash bags.

(3) With all of these collection methods, samples should be sprayed onto the wing/sheet or into the container at a similar distance from the nozzle and at the same flow rate and nozzle pattern setting as that used in the actual anti-icing operation.

b. Loss of Water Content. Prolonged or repeated heating of fluids may result in loss of water content, which can lead to performance degradation of the fluid. Deicing/anti-icing fluids should not be heated to application temperatures until necessary for application, if possible, and cycling the fluid to application temperatures and back to ambient temperatures should be avoided. For Type I fluids, the water loss caused by prolonged/repeated heating may cause undesirable aerodynamic effects at low ambient temperatures. For Types II, III, and IV fluids, the thermal exposure and/or water loss may cause a reduction in fluid viscosity, leading to earlier failure of the fluid and therefore invalidating the applicable HOT.

Note: Adding water to Types II, III, and IV fluids will not repair the damage caused by the previously mentioned conditions.

c. Other Types of Fluid Degradation. Other types of fluid degradation may result from chemical contamination, or in the case of Types II and IV fluids, excessive mechanical shearing attributed to the use of improper equipment/systems, such as pumps, control valves, or nozzles.

11. Fluid Application. Guidelines for appropriate application of deicing/anti-icing fluids are provided in the FAA HOT Guidelines document, which includes separate tables for the application of Type I fluid (Table 47, Guidelines for the Application of SAE Type I Fluid), Types II/IV fluid (Table 48, Guidelines for the Application of SAE Type II and IV Fluid), and Type III unheated fluid (Table 49, Guidelines for the Application of Unheated SAE Type III Fluid). These tables are updated annually, as required.

> **Note:** Fluid application tables published by other entities may not provide equivalent information to those published by the FAA. Therefore, the FAA HOTs and allowance times are not applicable unless the guidance in the FAA fluid application tables is used.

12. Alternative and New Technologies.

a. Forced Air Systems (FAS).

(1) General. FAS are designed to remove frozen contamination by the use of forced air and/or forced air augmented with Type I fluid injected into or sprayed over a high-speed air stream, or to apply Type II, III, or IV fluids over the air stream as an anti-icing process. In the case of Type I fluids, aircraft surfaces must be anti-iced with heated Type I fluid without using forced air if Type I HOTs are to be used. Depending on the specific system, the operator may be able to select from several FAS modes, including:

- Forced air alone.
- Forced air augmented with Type I fluid.
- Type II, III, or IV fluids applied over the forced air stream.

(2) Possible Concerns with FAS.

(a) Testing has indicated that the viscosity of Types II and IV fluids can degrade when applied by FAS. This degradation is influenced by the velocity and pressure of the forced air stream and the distance between the forced air nozzle and surface being anti-iced. Additionally, FAS-applied fluid mixtures may be unduly aerated, as evidenced by an overly foamy, milky-white, or frothy appearance. This may result in lower than published HOTs for Types II, III, and IV fluids. FAS dispensing Types II, III, and IV fluids must be viscosity tested.

(b) Another factor that may reduce HOTs is the apparent tendency of the high-speed air stream to thin out the fluid film as it is being applied. Therefore, operators must ensure that surfaces to be anti-iced are covered adequately in order to use the published Types II, III, and IV HOTs. The operator must ensure that an adequate coating of fluid is applied to aircraft surfaces, a procedure that may require several passes of the fluid spray over the area being protected. This usually means applying fluid in such quantities whereby the Type I deicing fluid is displaced, and the Type II, III, or IV fluid is running off in considerable amounts on sloped surfaces and running off flat surfaces as well.

(c) Before using Type II, III, or IV fluid-specific or generic HOTs, each operator must demonstrate, by spraying and viscosity testing, that its equipment, or equipment operated by other parties to deice/anti-ice the operator’s aircraft, is capable of applying these fluids without excessive shearing, such that they would no longer meet LOWV requirements. The lowest acceptable delivered viscosity can be determined by multiplying the LOWV by the ratio of the fluid viscosity in the storage device divided by the fluid viscosity from the forced air spray sample recovered from the wing, and for Types II and IV fluids, rounded up to the nearest 500 millipascal seconds (mPa·s).

Note: Use the manufacturer's viscosity test method from Tables 44 through 46, Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance, in the FAA HOT Guidelines document while conducting these or similar tests.

Note: The APS Aviation Inc. test procedure, Test Program – Forced Air Systems – Type II/III/IV Fluid Applied Over the Forced Air Stream, provides an example of how these tests can be conducted and the calculations required to determine the lowest acceptable delivered viscosity of a fluid intended to be used with an FAS.

(d) The FAA recommends that nozzles be kept at a low angle to the surface of the aircraft to avoid excessive fluid shear damage, aircraft surface damage, and foaming. Fluid applied by forced air should not contain excessive foam, as evidenced by an overly foamy, milky-white, or frothy appearance, and should be applied in an even coverage coating, which may require several passes over the area on the aircraft being anti-iced. The coating should be similar in thickness to a coating of fluid applied by conventional means (using a nozzle designed to apply thickened fluids, usually at a reduced flow setting).

Note: Except for application equipment and fluids that have been tested, and using fluid of sufficient viscosity to meet LOWV requirements in the air assist mode, published HOT guidelines (including generic) must not be used when using forced air unless followed by the application of anti-icing fluid without forced air.

(e) Adhere to airframe manufacturer cautions when operating FAS. For example, do not exceed the airframe manufacturer's limits regarding surface temperature and impact pressure on aircraft surfaces. This information is usually found in the Aircraft Maintenance Manual (AMM).

(3) Additional Precautions for FAS.

(a) Ear protection is required when noise levels exceed 85 decibels (dB).

(b) Exercise caution around ground personnel. The potential for blowing ice chunks that may strike ground personnel, and restricted visibility due to blowing loose snow, are possible problems.

(c) Exercise caution to avoid the following:

- Directing forced air into sensitive aircraft areas (e.g., pitot tubes, static ports, and vents).
- Blowing snow or slush into landing gear and wheel wells.
- Blowing ice, snow, and slush into aircraft engine inlets, auxiliary power unit (APU) inlets, and control surface hinges.
- Allowing loose debris to impact other aircraft surfaces.

Note: Information regarding a specific system can be obtained from the manufacturer's technical literature. SAE Aerospace Information Report (AIR) 6284, Forced Air or Forced Air/Fluid Equipment for Removal of Frozen Contaminants, provides some information on FAS usage, limitations, and precautions. This document is available at https://www.sae.org/standards/content/air6284.

b. Liquid Water Equivalent Systems (LWES). LWES have been in development for a number of years. They include HOT determination systems (HOTDS). At this time, SureHOT and SureHOT+ provided by SureWx Inc. are the only LWES available by operations specification (OpSpec). All of these systems convert snowfall data and other types of winter precipitation data into liquid water equivalent (LWE) data, which is then used to develop a HOT. The precipitation rate determined by these devices is matched with HOT data developed when fluids are tested in natural snow conditions, and artificial conditions for other precipitation types, to determine a HOT for a particular fluid type in the case of Type I fluids, and for a specific fluid name brand and type for Types II, III, and IV fluids. FAA Order 8900.1, Volume 3, Chapter 27, Section 5, Liquid Water Equivalent Systems, describes the approval process for using these devices to determine HOTs as part of an FAA-approved program.

c. Electronic Hand-Held Devices to Determine Electronic Holdover Times (eHOT). Electronic devices that determine eHOTs may be used as part of an air operator's § 121.629 winter operations plan submitted to the FAA for approval. If for any reason the device or application fails, or if the user has any concern regarding the accuracy of the data being displayed, printed tables sourced from the FAA HOT Guidelines must be used as a fallback information source. Questions regarding the use of these devices should be submitted via email to charles.j.enders@faa.gov or via phone at 202-267-4557.

13. Concerns/Conditions.

a. Starting and Stopping the HOT Clock. Once the HOT time clock has been started, it must not be stopped for intermittent precipitation. Intermittent precipitation conditions during ground icing operations are a common occurrence at some airports. As precipitation falls on an aircraft that has been anti-iced, the fluid is diluted. The more diluted the fluid becomes, the more readily it flows off the aircraft, and the higher the freezing point becomes. Even if the precipitation stops, the diluted fluid will continue to flow off the aircraft due to gravity. There is no practical way to determine how much residual anti-icing fluid is on the wing under these circumstances. HOT values under these conditions have not been assessed. Therefore, after the anti-icing HOT clock has been started, it must not be stopped. HOT credit cannot be given due to the fact that the precipitation has temporarily stopped falling.

b. Flightcrew Awareness of Conditions Affecting the Aircraft Anti-Icing Treatment Following Deicing and Anti-Icing Operations. The operator's deicing plan must provide a process that informs the captain of the time of the deicing/anti-icing treatment and conditions that could have affected the aircraft anti-icing treatment since that time. If the flightcrew is not present at the time of the deicing/anti-icing application, the crew will review this information before calculating the HOT.

c. Early Fluid Failure on Extended Slats and Flaps.

(1) Research into HOTs on deployed flaps/slats began in the winter of 2009–2010, and since 2011–2012 has included cooperative efforts with industry. Data collected has provided a substantive amount of evidence that demonstrates extended flaps/slats can accelerate anti-icing fluid runoff from aircraft wings, in turn negatively affecting the protection capacity of the fluid. This results in a potential safety risk. The protection capacity of the fluid is affected by many elements: the aircraft design, the slope of the surface, the type of fluid, the aircraft skin and ambient temperature, the type of precipitation, the amount of fluid applied, and the effective wind.

(2) To mitigate this safety risk, it was determined by the FAA and TC that adjusting the published deicing/anti-icing fluid HOTs and allowance times to 76 percent of the current published values would provide the sufficient safety margin to safely allow operations when flaps and slats are deployed prior to deicing/anti-icing. Therefore, when flaps and/or slats are extended to the takeoff configuration prior to deicing/anti-icing fluid application and remain in that configuration while taxiing to takeoff, the HOT and allowance time tables identified as "Adjusted" must be used. These 76 percent adjusted tables replace the 90 percent adjusted tables that were published for the winters of 2014–2015 to 2016–2017. Note that the standard HOTs and allowance times can be used if flaps and slats are deployed as close to departure as safety allows.

Note: Industry data indicates the possibility of increased takeoff misconfigurations when the selection of takeoff flaps is delayed later in the taxi regime. Whether an air carrier chooses to select the flaps/slats to the takeoff configuration prior to beginning the anti-icing process, operators should have robust procedures in place to ensure that the aircraft is properly configured prior to takeoff. Air carriers should follow the manufacturer's recommended procedures regarding anti-icing operations and the configuration of flaps/slats while taxiing.

d. Aircraft Failure to Rotate When Anti-Iced With Type II or IV Fluid.

(1) The FAA has become aware of some instances where aircraft failed to rotate after being anti-iced with Type IV fluid. This situation has been confined mostly to slower rotation speed turboprop aircraft; however, one occurrence involved a small corporate jet. Typically, these aircraft have nonpowered flight controls that rely on aerodynamic forces to achieve rotation.

(2) When excessive amounts of Type IV fluids are sprayed on the tail surfaces, the gap between the horizontal stabilizer and the elevator can become blocked with fluid and restrict the airflow needed for proper deflection of the elevator, resulting in difficulties with rotation, including high stick forces being encountered by pilots. Operators are cautioned to avoid spraying these aircraft tail areas from the rear, and should always apply fluid in the direction of airflow, from front to rear. Although they should be completely covered, these aft areas should not be flooded with excessive amounts of Type IV fluids.

Note: These concerns apply equally to applications of Type II fluids.

e. Deicing and Anti-Icing Fluid Compatibility.

(1) Research has indicated that the effectiveness of Type II and Type IV fluids can be seriously diminished if proper procedures are not followed when applying them over Type I fluid; specifically, a sufficient quantity of Type II or Type IV fluid should be applied to displace any remaining Type I fluid from the aircraft surfaces.

(2) Operators should ensure that the Type I and Type II/IV fluids being used on their aircraft are compatible. This can be accomplished by contacting the respective fluid manufacturer(s).

f. Non-Glycol Deicing Fluids Containing Alkali Organic Salts (AOS). There has been evidence that some non-glycol-based Type I fluids may pose a significant safety hazard when given their impact on anti-icing fluid. Specifically, Type I fluids containing AOS have been shown to significantly degrade thickening agents contained in anti-icing fluids, potentially resulting in a reduction of the fluid's viscosity and HOT. Operators should ensure that the Type I and Type II/IV fluids being used on their aircraft are compatible. This can be accomplished by contacting the respective fluid manufacturer(s). It is preferable that operators avoid the use of any deicing fluid containing AOS. In operational situations where this may not be possible, special attention should be given to ensure that a sufficient amount of anti-icing fluid has been applied to ensure complete removal of this deicing fluid so that the anti-icing fluid will have the appropriate HOT.

g. Possible Effects of Runway Deicer on Thickened Aircraft Anti-Icing Fluids.

(1) Most current runway deicing/anti-icing material contains organic salts that are not compatible with thickened aircraft anti-icing fluids. These salts cause the thickening agents within the aircraft deicing fluids to break down, reducing the viscosity of the anti-icing fluid and causing it to flow off the airframe more quickly. This reduction in the amount of anti-icing fluid will have an impact on the length of time that the anti-icing fluid will continue to provide adequate anti-icing protection.

(2) During landing, if runway deicing fluid is expected to have been splashed or blown up onto a critical surface, those surfaces should be thoroughly washed with deicing fluid or hot water (if temperature appropriate) prior to applying anti-icing fluids. This is normally accomplished during a routine two-step deicing/anti-icing process; however, during a preventive anti-icing fluid application, this cleansing step is often not accomplished. During taxi operation for takeoff on taxiways that have been deiced/anti-iced, flightcrews should be conscious of the effects of having the runway deicing fluid blown up onto the aircraft by preceding aircraft jet blast.

h. Inspection of Single-Engine, High Wing Turboprop Aircraft.

(1) In recent years, there has been a disproportionate number of ground icing accidents associated with improper checking/inspection of single-engine, high wing turboprop aircraft employed in commercial service. This is especially true of such aircraft operated from remote

locations with minimum facilities. In several of these accidents, it could not be determined whether the aircraft had been inspected/checked by the operator/pilot prior to departure. HOTs were not an issue because, at the time of attempted departure, there was no active precipitation. Typically, these accidents occurred during the first flight of the day following a freezing precipitation event that had occurred earlier.

(2) For these types of operations, the single pilot/operator was usually the final person to perform the pretakeoff check. On one aircraft in particular, it has been shown that it is difficult to see clear frozen contamination from a glancing view of the upper wing surface area (looking rearward from the wing's leading edge) when the pilot uses the wing strut/step to see the aft portion of the wing. Visual inspections can best be achieved by using inspection ladders or deicing ladders to achieve a higher vantage point to view the aft upper wing surface area. A number of ladder manufacturers provide wing inspection ladders that are ideal for this task. POIs are encouraged to discuss these observations with their operators and to ensure that operators employ adequate means to allow a pilot to clearly see the entire upper wing surface from a suitable height above the wing.

i. Tactile Inspection of Hard Wing Airplanes (No Leading Edge Devices/Slats) With Aft-Mounted, Turbine-Powered Engines. The following guidance is provided for tactile inspection clarification for part 121 operators of hard wing airplanes with an approved § 121.629(c) deicing program. There are three possible times that a tactile check should be accomplished in this type of operation:

(1) The conditions are such that frost or ice might be adhering to the aircraft, such as 10 °C (50 °F) or colder and high humidity or cold-soaked wings, all without active precipitation. Under this condition, a tactile check should be performed as part of the cold weather preflight requirements.

(2) If the aircraft is deiced, the postdeicing check to confirm that all the contaminants have been removed from the critical surfaces should be accomplished through the use of a visual and tactile check.

(3) If the aircraft has been anti-iced with anti-icing fluids and the prescribed HOTs have been exceeded, the required pretakeoff contamination check required within 5 minutes before takeoff must be accomplished through a visual and tactile check of the critical surfaces.

j. Fluid Dry-Out.

(1) Reported incidents of restricted movement of flight control surfaces while in flight attributed to fluid dry-out have continued. Testing has shown that diluted Types II and IV fluids can produce more residual gel than neat fluids. This is primarily due to the practice in some geographic locations of using diluted, heated Types II and IV fluids for deicing and anti-icing. Operators should be aware of the potential for fluid residue on their aircraft when operating to locations in Europe or other locations where deicing and anti-icing is conducted with diluted Type II or IV fluids.

Note: Changing from Type IV fluid to Type II fluid will not necessarily reduce fluid dry-out problems.

(2) Such events may occur with repeated use of Types II and IV fluids without prior application of hot water or Type I fluid mixtures. This can result in fluid collecting in aerodynamically quiet areas or crevices, which does not flow off the wing during the takeoff ground roll. These accumulations can dry to a gel-like or powdery substance. Such residues can rehydrate and expand under certain atmospheric conditions such as high humidity or rain. Subsequently, the residues freeze, typically during flight at higher altitudes. Rehydrated fluid gels have been found in and around gaps between stabilizers, elevators, tabs, and hinges. This especially can be a problem with nonpowered controls. Some pilots reported that they have descended to a lower altitude until the frozen residue melted, which restored flight control movement.

(3) Some European air carriers have reported this condition in which the first (deicing) step was performed using diluted, heated Type II or IV fluids followed by Type II or IV fluids as the second (anti-icing) step, or by using these heated, thickened fluids in a one-step deicing/anti-icing process. To date, North American air carriers have not reported such occurrences. Typically, North American air carriers use a two-step deicing/anti-icing procedure in which the first step is generally a heated Type I fluid mixture.

(4) Operators should check aircraft surfaces, quiet areas, and crevices for abnormal fluid thickening, appearance, or failure before flight dispatch if Type II or IV fluids are used exclusively to deice/anti-ice their aircraft. If an operator suspects residue as a result of fluid dry-out, an acceptable solution is to spray the area with water from a spray bottle and wait 10 minutes. Residue will rehydrate in a few minutes and be easier to identify. This residue may require removal before takeoff.

(5) If aircraft are exposed to deicing/anti-icing procedures likely to result in dehydrated fluid buildup, clean the aircraft in accordance with the aircraft manufacturers' recommendations. This cleaning should be accomplished with hot Type I fluid and/or water mix, or other aircraft manufacturer recommended cleaning agents. These cleaning procedures may require subsequent lubrication of affected areas. If evidence of fluid dry-out is present, an increase in the frequency of inspection of flight control bays and actuators may be necessary.

k. Wingtip Devices Identified as Critical Surfaces. Wingtip devices have various names, including winglets, strakes, sharklets, or raked wingtips. The guidance below applies for these devices.

(1) Without Split Scimitars or Strakes (Winglets, Sharklets, etc.). These devices must be confirmed to be free of frozen contamination as part of the pretakeoff check. Current practices include a visual scan or the use of an approved representative surface, as specified in the operator's FAA-approved ground deicing program.

(2) With Split Scimitars, Strakes, or Similar Devices. A new wingtip device element, the strake, has been introduced and is part of the split scimitar. The strake is installed outboard of the vertical component of the wingtip device and extends downward and, therefore, cannot be observed from inside the aircraft. Manufacturers may designate the upper inboard surface of the vertical element of the wingtip device as a representative surface to assure no frozen contamination is present. The anti-icing procedures specified require this inboard surface to be

anti-iced first starting at the top and working downward. The strake is anti-iced after the inboard surface application is completed. A visual scan of the designated representative surface (upper inboard surface of the vertical element of both wingtips) is required prior to takeoff as part of the pretakeoff check. This paragraph applies only to aircraft with split scimitar wingtip devices. This guidance will be revised when new wingtip types become available.

(3) Boeing Wingtip Devices Currently in Use on the B737 (Including Wingtip Devices with Split Scimitar Elements), B747, B757, B767, and MD11. Boeing has demonstrated that these wingtip devices do not require a visual inspection as part of the pretakeoff check if a complete deicing of these wingtip device surfaces is accomplished during the aircraft deicing procedure. Following the accomplishment of the wingtip device deicing procedure, no further action concerning the wingtip device is required as long as the determined HOT does not expire before departure. Upon expiration of the determined HOT prior to departure, a pretakeoff contamination check must be accomplished. This check must include a visual inspection of the wingtip devices, and if adhering frozen contamination is detected, the aircraft must return for appropriate ground deicing/anti-icing retreatment prior to departure.

l. Cold Soaked Fuel Frost (CSFF). An exemption process has been established to allow takeoff with CSFF adhering to the top of the wing. This exemption applies only to the Boeing 737-600/-700/-800/-900 series aircraft. Operators can petition for a summary grant on this issue.

m. Fluid Freezing in Flight. It is possible for anti-icing fluid to flow back to aerodynamically quiet areas of aircraft wings after takeoff where the residual fluid can partially freeze or appear thickened. Research indicates that this can occur on a regular basis but poses no risk to safety. Anti-icing fluids are designed in such a way that most of the fluid will flow off aircraft wings, particularly from the leading edge. The leading edge is the most aerodynamically critical section of the wing, whereas its trailing edge can accrue some residual fluid and remain acceptable for safe operations.

n. Anti-Icing in a Hangar.

(1) There are operational conditions when air operators may choose to anti-ice their aircraft while the aircraft is in a heated hangar. This is one way to reduce the consumption of deicing fluid and to minimize the environmental impact of deicing.

(2) The period of time after fluid application and the air temperature in the hangar both have an effect on the ability of the fluid to protect the aircraft when it is pulled out of the hangar and into freezing/frozen precipitation. The HOT for a fluid is based largely on the fluid's thickness on the surface. The fluid thickness varies with time and temperature. Unless otherwise approved in an air operator's program, the HOT clock must be started at the time of the first application of anti-icing fluid onto a clean wing. It may not be started when the aircraft is first exposed to freezing/frozen precipitation.

(3) When anti-icing T-tail aircraft in a hangar, care must be taken to ensure that the horizontal stabilizer/elevator of the aircraft is not in close proximity to the ceiling heating

system. Excessive heating of these critical surfaces during and after anti-icing can reduce applied anti-icing fluid thickness below what is required to achieve the HOT.

(4) If it is impossible to position the aircraft in such a way that the tail section is not below a heating element, consider disabling the heating element before, during, and after anti-icing. Alternately, consider opening the hangar doors to cool all surfaces if this can be done without exposing the aircraft to additional contamination.

14. Action.

a. Distribution. POIs will provide a copy of this notice to the appropriate 14 CFR part 119 management personnel of his or her assigned air carrier. POIs must distribute the HOTs to all parts 121, 125, and 135 certificate holders who have an approved part 121 deicing/anti-icing program. They also should distribute HOT and application guidelines to operators who are not required to have an approved program, but who deice or anti-ice with fluids and use these guidelines during winter weather operations. The attached HOT and application guidelines supersede all previously approved HOT and application guidelines for application of deicing/anti-icing fluid mixtures.

b. HOT Guidelines. POIs must inform their certificate holders of all guidance provided in this notice as well as the FAA Holdover Time Guidelines for Winter 2020-2021. POIs should recommend that these HOT tables and application guidelines be incorporated into the certificate holder’s procedures or programs. Certificate holders should use these tables and application guidelines or the data contained in them to develop tables and guidelines that are acceptable to the Administrator.

c. Information for Deicing/Anti-Icing Updates. POIs must provide the carriers with the following information, which should be incorporated into their approved ground deicing/anti-icing updates for the 2020–2021 winter season:

(1) Fluid Application.

(a) During previous seasons, surveillance of deicing/anti-icing operations has indicated several problems in fluid application. These findings include:

- Instances when fluid was applied in the reverse order of company-approved procedures (e.g., approved procedure being wing tip to wing root).
- Insufficient fluid temperature buffers.
- Incomplete removal of contamination.

(b) Frozen contamination on wing surfaces at altitude has been reported.

(c) To minimize such occurrences, when performing a deicing/anti-icing procedure, accomplish the first step (deicing) by applying the hot fluid with the nozzle as close to the surface as possible without damaging aircraft surfaces. Increasing the distance from the nozzle to the surface results in progressively greater loss of fluid heat and deicing capability. This condition is aggravated as the fluid application pattern is adjusted toward a fine (small droplet size) spray mode. Also, maintain a safe distance between deicing equipment and aircraft surfaces to avoid contact.

(d) Additionally, cover the entire aircraft surface directly by the deicing operation (except windows or other areas where a direct spray is not recommended) rather than relying on fluid flow-back over contaminated areas. This will provide greater assurance that no frozen precipitation remains under the deicing fluid.

(e) As a final precautionary step, apply sufficient fluid to ensure that any remaining diluted fluid on the deiced surfaces (as a result of the deicing process) is displaced by a fluid with a freezing point of at least 10 °C (18 °F) below the OAT if anti-icing with Type I fluid. In the case of Types II, III, and IV fluids, ensure they are applied in the temperature ranges for undiluted or diluted, as shown in the HOTs, and that quantities are sufficient to displace deicing fluid. This can be indicated by these anti-icing fluids running off in considerable quantities on sloped surfaces and running off flat surfaces also. If applied according to the respective HOTs, the freezing point buffer requirement of at least 7 °C (13 °F) below the OAT will be met. Determine this by checking the refractive index/Brix (refer to the manufacturer's information).

Note: The freezing point of 10 °C (18 °F) below the OAT refers only to a Type I fluid. Historically, Types I, II, and IV fluids application guidelines have recommended a minimum fluid temperature of 60 °C (140 °F) at the nozzle for deicing. Field testing using properly functioning deicing equipment has shown that fluid temperatures of 60 °C (140 °F) at the nozzle are readily obtained and usually 10 °C (18 °F) higher.

(f) The effectiveness of Types II, III, and IV fluids is highly dependent on the training and skill of the individual applying the fluids. When these fluids are used, ground personnel should ensure that they are evenly applied so that all critical surfaces, especially the leading edge of the wings, are covered with fluid. In addition, an insufficient amount of anti-icing fluid, especially in the second step of a two-step procedure, may cause reduced HOT because of the uneven application of the second-step fluid.

(g) In very cold conditions (generally below -10 to -15 °C (14 to 5 °F) or colder), dry snow or ice crystals can fall onto cold aircraft wings. Under these conditions, these forms of precipitation will swirl as they blow across the wings, making it evident they are not adhering. But, if either has accumulated on the surface of the wings and it cannot be adequately demonstrated that they are not adhering to any portion of the wing, they have to be removed before takeoff. It cannot be assumed that these accumulations will blow off during takeoff.

(h) The aircraft operator will need to test multiple areas along the entire length and width of both wings, and should take into consideration the location of heat-releasing components in the fuel tanks such as hydraulic fluid heat exchangers. The testing should be accomplished after refueling. Factors that could affect adherence must be taken into consideration. These would include weather, temperature, aircraft parking location (e.g., one wing in the sun), and potentially other factors.

(2) Communication.

(a) Communication among all personnel involved in the deicing/anti-icing of an air carrier's aircraft is critical to ensure that the pilot has the information needed to make the final determination that the aircraft is free of adhering contamination before flight. Approved programs should emphasize that all personnel (e.g., management personnel, dispatchers, ground personnel, and flightcrew members) who perform duties, as outlined in the approved program, clearly and concisely communicate essential information to ensure that no frozen contaminants are adhering to any critical surfaces of the aircraft. Some airports have introduced electronic signs to aid in the transmission of critical information to the flightcrews. This includes aircraft ground control information at the deicing pad and information on the ongoing deicing/anti-icing procedure and fluid application. Long-range plans are underway to employ Aircraft Communications Addressing and Reporting System (ACARS) data link systems of aircraft to relay deicing information to the flightcrews.

(b) Specifically, review approved programs to determine whether the ground personnel accomplishing the deicing/anti-icing procedure communicate the following information to the pilot:

- The Type fluid used (for Types II, III, and IV fluids, the specific manufacturer name and type fluid, or SAE Type II, SAE Type III, or SAE Type IV).
- The percentage of fluid within the fluid/water mixture (for Types II, III, and IV fluids only (not necessary for Type I fluid)).
- The local time the final deicing/anti-icing began.
- The results of the post-deicing/anti-icing check, unless the approved program has other procedures for ensuring this information is conveyed to the pilot.

(c) Although reporting the results of the post-deicing/anti-icing check may be redundant in some cases, it confirms to the pilot that all contamination has been removed from the aircraft.

(3) First Areas of Fluid Failure. Aircraft testing has indicated that the first fluid failures on test aircraft occur on the leading and/or trailing edges rather than the midchord section of the wing. Tests have also indicated that fluid failures may be difficult to visually identify. Where possible, representative surfaces should:

- Include a portion of the wing leading edge, and
- Be visible by the pilot from within the aircraft.

(4) Devices. For aircraft with wingtip devices, current practice used to ensure that no frozen contamination is present at takeoff is incorporated in the pretakeoff check. This incorporates a visual scan or using representative surface(s).

d. Operations During Light Freezing Rain/Freezing Drizzle.

(1) POIs should inform air carriers electing to operate in light freezing rain or freezing drizzle weather conditions to use Type II, III, or IV anti-icing fluids. Approved programs should

clearly state that deicing/anti-icing fluids do not provide any protection from contamination once the aircraft is airborne.

(2) Air carriers not electing to use Type II, III, or IV anti-icing fluids while operating during light freezing rain or freezing drizzle conditions should develop and use special procedures. Examples of special procedures include:

- An approved external pretakeoff contamination check.
- A remote deicing capability.
- Other special means of enhancing the safety of operation during these conditions (such as the use of advanced wide area optical technology capable of detecting aircraft contamination).

(3) POIs should use special emphasis surveillance during periods of light freezing rain and freezing drizzle. Surveillance should affirm that approved checks or other special procedures, as stated above, are effective and conducted in accordance with the air carrier's approved deicing/anti-icing program.

Note: Exercise care in examining engine air inlets for clear ice. Such frozen contamination can be dislodged and ingested into engines after startup. High rear-mounted engines may be difficult to inspect. The problem is compounded because clear ice may be difficult to detect visually and require tactile examination. Additionally, wide-area Ground Ice Detection Systems (GIDS) have been shown to be very effective in locating ice lodged in the air inlets of turbojet engines.

15. Activity Recording (AR) Input. Within 30 days of the effective date of this notice, POIs of 14 CFR parts 91 subpart K (part 91K), 121, 125, 129, and 135 certificate holders must make an AR entry for each of their assigned certificate holders to record accomplishment of the certificate management actions directed in paragraph 14.

16. SAS Surveillance Requirement.

a. Data Collection Tool (DCT). The POI will create and perform a principal inspector (PI) Custom DCT (C DCT) utilizing Master List of Functions (MLF) Element Design DCT (ED DCT) 6.4.2 (OP) Operations in Ground Icing to assess the response of the certificate holder. In creating the PI C DCT, be sure to choose the following selections:

(1) Enter "Ground Icing 20-21" in the "Custom DCT Name" field.

(2) Record this notice number in the "Local/Regional/National" field.

(3) Select the "Design" radio button.

(4) Ensure that "Yes" is selected for "Requires Own Assessment?"

(5) Leave the "LRN Locked?" checkbox unchecked.

b. Additional Surveillance and Action. The POI must determine if additional surveillance is required or further air carrier action is necessary to address the potential increased risk. Possible additional actions may include retargeting the Comprehensive Assessment Plan (CAP) to include accomplishing appropriate Design Assessments (DA) or Performance Assessments (PA), convening a System Analysis Team (SAT), or reevaluating air carrier approvals or programs.

17. Disposition. We will incorporate the information in this notice into Order 8900.1 before this notice expires. Direct questions or comments concerning the information in this notice to the Air Carrier Operations Branch (AFS-220) at 202-267-8166.

Robert C. Carty
Deputy Executive Director, Flight Standards Service

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