NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8900.196

National Policy

Effective Date: 8/16/12

Cancellation Date: 8/16/13

SUBJ: Revised FAA-Approved Deicing Program Updates, Winter 2012-2013

1. Purpose of This Notice. This notice provides inspectors with information on holdover times (HOT), a listing of deicing/anti-icing fluids, and recommendations on various other ground deicing/anti-icing issues.

2. Audience. The primary audience for this notice is Flight Standards District Office (FSDO) principle operations inspectors (POI) responsible for approving an air carrier's deicing program. The secondary audience includes Flight Standards personnel in FSDOs, branches, and divisions in the regions and at headquarters (HQ).

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

> **Note:** The Official FAA Holdover Time Tables for 2012-2013 and related tables referenced in this document can be found at the FAA Air Transportation Division (AFS 200) Ground Deicing Web site: http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/deicing.

4. Cancellation. This notice cancels N 8900.167, Revised FAA Approved Deicing Program Updates, Winter 2011-2012, dated 08/29/2011.

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). Advisory Circular (AC) 120-60, Ground Deicing and Anti-Icing Program, current edition, 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 and 14 CFR part 135, § 135.227(b)(3), allow both kinds of certificate holders to comply with a part 121-approved program.

6. Changes and New Information.

a. Type I Fluids. The Type I fluid HOT table values are unchanged.

b. Type II Fluids. A fluid-specific HOT table has been created for the new Type II fluid, LNT Solutions P250. The addition of this fluid did not impact the generic holdover times. A fluid-specific HOT table has been added for Clariant Safewing MP II Flight Plus. The addition of this fluid did not impact the generic holdover times. Two obsolete fluids, Clariant Safewing MP II 2025 Eco and Octagon E Max II have been removed from the Type II guidelines. Removal of these fluids did not impact the generic holdover times.

c. Type III Fluids. The Type III fluid HOT table values are unchanged.

d. Type IV Fluids. Two obsolete fluids, Clariant Safewing MP IV 2001 and Dow Chemical UCAR ADF/AAF Ultra+ have been removed from the Type IV guidelines. Removal of these fluids caused increases to twelve of the Type IV generic holdover times with nine cells being affected.

e. Octagon Branded Fluid Names. Due to the acquisition of the fluid manufacturing company Octagon Process by Clariant GmbH, fluids previously listed under the Octagon brand name are now listed under the Clariant brand name. These fluids include several Type I fluids (EcoFlo Concentrate, EcoFlo 2 Concentrate, Octaflo EF Concentrate, Octaflo EF-80 Concentrate, Octaflo EG Concentrate) and one Type IV fluid (Max-Flight 04).

f. Active Frost Holdover Times. The lowest temperature band in the Type I portion of the active frost table has been changed from "below -21 to -25 ºC" to "below -21 to -25ºC or LOUT." This change has been made to indicate that the Type I active frost holdover times below -25ºC as long as the lowest operational use temperature (LOUT) is not exceeded. Type I fluid LOUT's are listed in Table 7.1.

g. Snowfall Visibility Table. Table 1C, Snowfall Intensities as a Function of Prevailing Visibility, has been modified from last year. The snow intensity in the cell for night, temperature < -1 ºC, and visibility 3/4 mile has been changed to moderate. The intensity in the cell for night, temperature > -1 ºC, and visibility 1 mile has also been changed to moderate. New columns have been added for visibility 1¼ and 1¾ mile. With these columns added, the table now provides snow intensities for visibilities that are reported in the METARS in the United States.

h. Fluid Application Procedures. Wording was added to Tables 1B and 5 with respect to the time interval between the first and second step fluid applications. Wording was added to Tables 1B and 5 to clarify that the minimum fluid application quantities and temperature apply to all conditions, including active frost.

i. Ice Pellet Allowance Times. The Ice Pellet Allowance Time Table values are unchanged for 2012-13. However, Clarification has been added to the Ice Pellet Allowance Times section to identify additional precipitation conditions where outside air temperature (OAT) must not decrease.

j. Lowest Operational Use Temperature. The LOUT values (Table 7) were reviewed and updated.

7. HOT Guidelines.

- The Official FAA Holdover Time Tables for 2012-2013, which are located on the FAA Web site at http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/deicing , include FAA-approved HOT guidelines for SAE Type I, II, III, and IV fluids, ice pellet allowance times, and changes in guidance material for 2012-2013 from the previous year as listed in Section 6 of this document.
- FAA approved and SAE guidelines for the application of these deicing/anti-icing fluids are contained in the HOT Tables.
- The FAA Type II (Table 2, FAA Guidelines for Holdover Times SAE Type II Fluid Mixtures as a Function of Weather Conditions and Outside Air Temperature, located on the FAA Web site) and Type IV (Table 4, located on the FAA Web site) HOT guidelines comprise the generic HOT values and encompass the minimum (worst case) HOT values for all fluids for a specific precipitation condition, temperature range, and fluid mixture concentration. Air carriers may only use the fluid specific HOT guidelines (Tables 2A-2H and Tables 4A-4M, located on the FAA Web site) 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 2 or 4, as appropriate.
- Also included in the FAA HOT tables Table 8, List of Fluids Tested for Anti-icing Performance and Aerodynamic Acceptance Winter 2012-2013, located on the FAA Web site) is a list, by fluid-specific name, of Type I, II, III, and IV deicing/anti-icing fluids that have been tested for anti-icing performance and aerodynamic acceptance according to SAE AMS 1424 for SAE Type I fluids and AMS 1428 for SAE Types II, III, and IV fluids.

8. Fluid Characteristics, Associated Holdover Times and Other Related Information. FAA approved SAE guidelines for the application of these deicing/anti-icing fluids are contained in the HOT Tables.

a. Type I Characteristics. Type I fluids are Newtonian, non-thickened fluids used primarily for deicing, but may also be used for anti-icing with associated holdover times. 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 non-moving aircraft surfaces.

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

- Table 1, FAA Guidelines for Holdover Times SAE Type I Fluid Mixtures on Critical Aircraft Surfaces Composed Predominantly of Aluminum as a Function of Weather Conditions and Outside Air Temperature, for aircraft with aluminum wing surfaces, and
- Table 1A, FAA Guidelines for Holdover Times SAE Type I Fluid Mixtures on Aircraft Critical Surfaces Composed Predominantly of Composites as a Function

of Weather Conditions and Outside Air Temperature, for aircraft with composite wing surfaces.

Note: The Type I fluid holdover times for composite surfaces (Table 1A) must be applied to aircraft with all critical surfaces that are predominantly or entirely constructed of composite materials. However, the Type I fluid holdover times 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 holdover times, 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 holdover times 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 don't transfer heat very well. Within practical limits, the more heat that 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 wing tips.

Note: FAA Type I HOT guidelines are not approved for the application of unheated Type I fluid mixtures.

(2) Snow Conditions.

(a) The Type I HOT guidelines include three separate snow columns, representing the following categories: 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 extensive tests conducted by APS Aviation of Montreal, Canada, National Center for Atmospheric Research (NCAR) of Boulder, Colorado, and the Anti-icing Materials International Laboratory (AMIL) of the University of Quebec at Chicoutimi, Canada, during several prior winter icing seasons. These tests were conducted on behalf of the FAA and TC.

(b) Type I HOT values for liquid equivalent snowfall rates between 0.4 and 1.0 mm/hr (0.016 0.04 in/hr) are selected for the light snow column and HOT values for liquid equivalent snowfall rates between 0.3 and 0.4 mm/hr 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/hr.
- Potential wind effects.
- Light snow variability.
- Possible safety concerns associated with pretakeoff checks.

(3) Effectiveness of Heated Type I Fluids. The heating requirements for Type I fluids have been removed from Tables 1 and 1A (located on the FAA Web site) to avoid clutter, but remain in Table 1B, also located on the FAA Web site.

(a) As previously stated, Type I HOTs are heavily dependent on the heating of aircraft surfaces. Unlike Type 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 60º C (140º F) at the nozzle, as stated in Table 1B (located on the FAA Web site), 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 nominal 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 10º C (18° F) or less. Some manufacturers are producing equipment that uses instant on heat or last bypass heaters have indicated a temperature drop of 5º 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 60º C (140º F) at the nozzle is sufficient.

b. Type II, III, and IV Fluids Characteristics and Differences When Compared to Type I Fluids. Type II, III, and IV fluids are thickened Newtonian fluids. A Newtonian fluid is one whereby the viscosity (thickness) decreases when a shearing force is applied such as the air flow over aircraft surfaces on takeoff. When applied to aircraft surfaces these fluids form an anti-icing film which absorbs freezing or frozen contamination with the exception of ice pellets. Although thickened, Type III fluid is much thinner than Types 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) The HOTs for Type 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.

Note: All HOT values (except for snow) are determined in the laboratory under no wind conditions. Generally, wind reduces HOTs. Snow testing is conducted outdoors and may or may not involve varying winds. This can have varying effects on the test results.

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

(3) For Type I fluid (Tables 1 and 1A), note the statement in the commentary under that reads, "...freezing point of the mixture is at least 10º C (18º F) below OAT." The difference between the freezing point of the fluid and the OAT is known as the temperature or freezing point buffer. In this case, the buffer is 10º C (18º F), which you can interpret as the freezing point of the fluid being 10º C (18º F) below the OAT. The 10º C (18º 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 FPD fluid/water mixtures volumes.
- Differences between OAT and aircraft surface temperatures.
- Changes in OAT following fluid application.
- Differences in aircraft surface materials.
- Degradation of FPD fluid strength due to aging.
- Degradation of FPD strength due to pumping equipment.
- Wind effects.
- Solar radiation.

Note: For example, If the OAT is -3º C (27º F), the freezing point of the Type I fluid mixture should be -13º C (9º F) or lower, and the mixture applied at a minimum temperature of 60º C (140º F) at the nozzle before the HOT guidelines information in Table 1 (located on the FAA Web site) can be used.

(a) Under the Degrees Celsius column, below -3º C to -6º C for freezing drizzle, the HOT is 0:05 to 0:09, which is interpreted as a HOT from 0 hours and 5 minutes to 0 hours and 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.

(b) In all cells of Table 1 and Table 1A (located on the FAA Web site), except for light and very light snow, freezing drizzle, and freezing rain, where two values of time are entered, the precipitation intensity is light to moderate. For the very light snow 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 mm to 0.4 mm/hr and light snow has a rate of 0.4 mm to 1 mm/hr. 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/hr. 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, and hail. The FAA has developed allowance times and associated limitations for takeoff in light or moderate ice pellets, and light ice pellets mixed with other forms of precipitation listed in the ice pellet allowance time table (Table 9, Ice Pellet Allowance Times 2012-2013 (located on the FAA Web site)). Additionally, takeoff in heavy snow may be accomplished if the requirements for operating in this condition, which are located on the FAA Web site, are met.

(c) The FAA also emphasizes that air carriers should read and understand all notes and cautions, such as the reference to the 10º C (18º F) buffer, in the guidelines to preclude improper usage of the fluid.

(4) Differences exist between Type I, and Types II, III, and IV, fluids HOT guideline usage.

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

- Type I fluids are applied to maintain at least a 10º C (18° F) buffer between the OAT(LOUT) and the freezing point (LOUT) of the fluid/water mix.
- Type II, III, and IV fluids are used solely 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 10º C (18º F) buffer for Type I fluids and the appropriate fluid/water concentration (100/0, 75/25, or 50/50) for Type II, III, and IV fluids.

(b) The HOT for a Type I fluid is considerably less than that for a Type II, III, or IV fluid. 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 60º C (140º F) at the nozzle and applied at a rate of at least 1 liter/m2 (approximately 2 gallons/100 square feet). Since composite surfaces are very poor conductors of heat, the composite HOTs are shorter due to the lack of heat absorption on these non-metallic surfaces.

(c) Although Type I fluids are normally considered deicing fluids, and Types II, III, and IV are considered anti-icing fluids, all types have been used in the deicing and anti-icing mode. However, the performance of Type I fluid when used as an anti-icing agent is inferior to that of Types II, III, and IV. Also, heated and diluted Type 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. Type III fluid can also be used heated and diluted as HOTs for dilutions have been developed.

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

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

(e) 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.

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

(g) In addition, HOT guideline data were obtained for Type III fluids when applied heated and unheated and no significant HOT performance differences were observed. Therefore, anti-icing applications of Type III fluid may be heated or unheated.

(h) Most FPD fluids are ethylene glycol 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 Type II and IV fluids sensitive to viscosity degradation via shearing when being pumped or sprayed. Type III is less sensitive as it has a much lower viscosity.

(5) Tables dealing with Type II and IV fluids have a caution note (***) 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 “-3° C (27° 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). On rare occasions when these conditions do occur at temperatures below -10° C (14° F), you should exercise caution regarding HOT value usage.

(6) Only one HOT value is entered under the Frost column for a given temperature band. 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. You should only use the single time, as with all the times in the tables, as a guide. HOTs are for active frost conditions in which frost is forming. This phenomenon occurs when aircraft surfaces are at or below 0° C and at or below the dew point. Frost typically forms on cold nights with clear skies.

(7) A separate table, Table 7, Lowest Operational Use Temperatures of Anti Icing Fluids (2012-2013), located on the FAA Web site, provides LOUT information, which is based on aerodynamic performance (i.e., the fluid's ability to flow off the wing during takeoff) and the fluid's freezing point depression capabilities. This information can also be found on the bottom row of the fluid specific HOT tables.

9. Frost.

a. Active 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 the frost such as paint lines, markings, and lettering to be distinguished, it is often referred to as hoarfrost. Frost can also form on the upper or lower surfaces of the wing due to cold soaked fuel. Frost has the appearance of being a minor contaminant and does not offer the same obvious signal of danger 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. Frost forms whenever the exposed surface temperature cools below the OAT to, or below, the frost point (not dew point). The mechanisms for cooling include:

- Radiation cooling, or
- Conductive cooling (due to cold soaked fuel).

(1) 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 deicing/anti-icing fluid where the HOT has expired.

Note: 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.

(2) Dew Point and Frost Point. The dew point is the temperature at a given pressure to which air must be cooled to cause saturation. The dew point can occur below or above 0° C. 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 dew point. The Aviation Routine Weather Report (METAR) does not report frost point; however, it does report dew point. The frost point is higher (warmer) than the dew point for a given humidity in the air. The frost point and the dew point are the same at 0º C; at a dew point of -40º C, the frost point is 3.2º C warmer (-36.8º C). The following table provides further examples of the correlation between dew point and frost point.

Dew Point Temperature (°C)	Frost Point Temperature (°C
0	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

b. 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 (0.5 $g/dm^2/hr$) occurs with zero wind. The measured deposition rate of freezing fog at 1 and 2.5 meters/sec wind speeds are 2 and 5 $g/dm^2/hr$, 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.

10. Alternative De-Icing Systems.

a. Gas-Fired Infrared (IR) Systems.

(1) A gas-fired IR system is usually contained in a modular shelter facility. This system uses gas-fired units suspended from the ceiling of the modular shelter facility. It imparts sufficient IR-focused energy on the aircraft surfaces, which melts the frozen contaminants on the aircraft's surfaces that are in the line of sight of the IR units.

(2) With regard to such facilities, frozen contamination should be removed from aircraft surfaces before dispatch from the facility or anti-icing. The latter is generally accomplished within the facility after the deicing step, with the IR radiant energy at a reduced intensity. The reduced intensity during the anti-icing step is intended to prevent re-accumulation of frozen contamination (e.g., snow) that may blow through the open ends of the facility.

Note: The dehydration of Types II, III, and IV fluids, which may occur during constant and uninterrupted exposure to IR radiation, can adversely affect fluid performance. The FAA advises the user to contact the manufacturer of the IR deicing facility and/or fluid manufacturer to determine the limit of IR exposure to which the fluid can be safely subjected without a degradation of fluid performance.

(3) The IR units may continue to operate between the deicing and anti-icing steps to evaporate the frozen contamination that has melted. The FAA cautions that heated aircraft surfaces must not exceed manufacturer's limits and the aircraft manufacturer must approve the use of IR deicing on the composite structures of the aircraft. After removal of the IR energy source, surfaces that remain wet will require an application of heated deicing fluid to preclude

refreezing. When required (for operations other than frost or leading edge ice removal and when the OAT is at or below 0º C (32º F), an additional treatment with heated deicing (Type I) fluid must be performed within the facility to prevent refreezing of water, which may remain in hidden areas.

Note: IR deicing systems should not be used to remove previously applied deicing/anti-icing fluid from aircraft surfaces.

b. Forced Air Deicing Systems (FADS).

(1) Overview. The military and foreign air carriers have used FADS for years, but these were largely limited to the removal of loose snow. Many of these systems were converted auxiliary power units (APU) and had a tendency to be unwieldy.

(a) The current generation of FADS is easier to handle and is designed to remove frozen contamination by the use of forced air and forced air augmented with a Type I fluid injected into the high speed air stream. Although heated fluid is more effective, the fluid can be heated or unheated; however, the aircraft surfaces will need to be deiced and anti-iced with heated Type I fluid after deicing with forced air if Type I HOTs are to be used. Depending on the specific FADS, the operator may be able to select from several FADS modes, including:

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

Note: These capabilities make the current generation of FADS more versatile than its predecessors.

(b) Some systems have an additional mode of operation: a fluid only mode. This mode is not as effective as the application of Type I fluid using conventional equipment, mainly because some FADS expel less fluid.

(c) Some systems have been retrofitted onto operational deicing vehicles without compromising the vehicle's original capability. This modification allows the vehicle to operate as a FADS or conventional deicing unit. A separate vehicle and deicing system operator are usually required. However, some units may be fully operated from the deicing bucket/cab. In a manner similar to typical deicing operations, directional control of the discharge nozzle is accomplished from controls in the deicing bucket/cab.

(2) Possible Concerns with FADS.

(a) The guidelines previously noted that Type I fluid was injected into the high speed air stream. Generally, FADS units are not limited to Type I fluid. However, testing has indicated that the viscosity of Type II and IV fluids may degrade when applied by FADS. This degradation appears to be influenced by the velocity and pressure of the forced air stream and the distance between the forced air nozzle and surface being deiced. For direct injections, FPD fluid viscosity has been shown to degrade more as the forced air velocity increased and as the distance between the FADS nozzle to the surface being deiced decreased.

(b) Additionally, FADS 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 Type II and IV fluids.

(c) Another factor that may reduce HOT in the air/fluid mode for all fluids is the apparent tendency of the high speed air stream to thin out the fluid film as it is being applied. 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.

(d) During the 2002-2003 winter icing season, the FAA and TC, in conjunction with two air carriers, conducted tests to characterize the deicing performance of FADS and their effects on HOT guidelines. Tests were conducted at several locations, using the FADS in both the fluid injection mode and in the air assist mode.

(e) In the injection mode, Type IV anti-icing fluids were injected directly into the forced air stream of the forced air delivery system; in the air assist mode, anti-icing fluids were applied over the forced air stream and allowed to drip/fall into the forced air stream. The desired results included validation of the ease of application of anti-icing fluids to include increased application distances and easier spreading of fluids on aircraft surfaces. Also tested was the potential for the use of less fluid during the anti-icing procedure.

(f) Following application using both the injection mode and the air assist mode, the applied fluids were recovered and analyzed for viscosity, aeration, and HOT performance. Results of viscosity evaluations from the fluids recovered from the air injection mode were determined to be unacceptable. Significant decreases in the fluids' viscosities on the order of 40-50 percent were observed. Thus, the conclusion was that the HOT guidelines should not be used when the anti-icing fluids are directly injected into the forced air stream. Use of the air assist mode to apply anti-icing fluid to deiced surfaces produced viscosities that were endorsed for the 2003-2004 winter icing season. The units/equipment/fluid involved included:

- FMC LMD deicing truck.
- Forced air delivery pressure @ 13 pounds per square inch (psi).
- Type IV fluid nozzle rated @ 20/25 gpm @ 50 psi.
- Fluid specific brand: Clariant Safewing MP IV 2001.

(g) During the 2003-2004 winter icing season, additional tests were conducted in conjunction with an air carrier. These tests, employing six Type IV fluids, were designed primarily to assess the effects of applying Type IV fluids in the air assist mode from a FADS. The fluids were applied employing both conventional anti-icing applications methods and the forced air assist method. FMC LMD 2000 and the FMC Tempest II Ground Deicing Equipment with standard application pressures and flow rates were employed in the tests. Before measuring viscosities, the fluid samples were centrifuged to remove entrapped air bubbles as recommended in Brookfield viscosity measurement practices. Two fluid viscosity measurement samples were taken from four sources/locations during the process. These included:

- Fluid Delivery Tote.
- Truck Tank.

- Test wing employing conventional anti-icing application.
- Test wing employing forced air assist application.

(h) Results were mixed. Shearing in four of the six fluids tested produced viscosities below acceptable lowest on wing viscosities (LOWV) and these fluids were deemed to be unsatisfactory for forced air assist applications. The LOWV represents the lowest viscosity that a fluid should have after it has been applied to an aircraft wing. Applied fluids with viscosities lower than the LOWV may produce HOTs shorter than those given in the HOT guidelines. Two of the fluids produced samples that exhibited viscosities above the LOWV values. The acceptable viscosities were deemed to be a function of the initial viscosities of the samples tested. One fluid, Clariant Safewing MP IV 2001, was found to produce acceptable viscosity values above its LOWV when its initial viscosity was 90 percent of the upper end of its production range of 30,000 mPas. The other fluid, Clariant Safewing MP IV 2012 Protect, was found to produce acceptable viscosity values above its LOWV when its initial viscosity was 75 percent of the upper end of its production range of 20,000 mPas, although this fluid is no longer available.

(i) Additional anti-icing fluids employing forced air delivery systems that have been optimized for anti-icing applications (e.g., lower air pressures, different fluid velocities and spray patterns, different contact angles between the forced air stream and the fluid spray) may prove to provide acceptable HOT results when applied in the air assist mode.

(j) During the 2004-2005 winter icing season, additional tests were conducted in which the air pressures and fluid flow rates were optimized to reduce fluid shearing while still providing an effective fluid spray pattern. This round of tests again used FMC LMD 2000 and FMC Tempest II deicing vehicles that had been modified as follows:

- The fluid and air nozzles were separated 7 inches centerline to centerline by inserting 3 inch spacers.
- The Type IV fluid flow rate was increased from 20 to 25 gpm.
- The forced air delivery pressure was decreased from 13 to 6 psi.

(k) The tip of the spray nozzle was positioned 4.75 feet above the wing and 10.5 feet from the spray target marked on the wing. Fluid samples were taken from fluid delivery tote containers before spraying and from the surface of a Lockheed Jet Star wing used as a spray target. All tote and wing samples were centrifuged before viscosity testing to remove air bubbles that can affect viscosity testing accuracy. Tests were run with and without an air sleeve inserted into the forced air nozzle. The air sleeve is a removable cross shaped device that runs the length of the air nozzle chamber. It splits the air into four quadrants before it exits the nozzle and produces less turbulent airflow.

(l) Additional tests were run in 2007 with FMC Tempest, FMC LMD 2000, and with Global Air Plus forced air equipped trucks at reduced air pressure at the air nozzle (6 psi for the FMC, 6 to 9 psi for the Global), with an air sleeve installed in the air nozzle chamber, 7 inches between the air and fluid nozzles centerlines on the FMC trucks, 8 inches on the Global, and a fluid flow rate of 25 gallons per minute. The results were included in the table below. The fluid used during this series of tests was Clariant Safewing MP IV Launch.

(m) Tests were also run in 2007 with FMC Tempest, and Global Air Plus trucks using the Type III fluid, Clariant Safewing MP III 2031 ECO. The air pressure was reduced to 6 psi on the Global, and 11 psi on the FMC truck. Two flow rates, 10 gpm and 60 gpm were used, with the 10 gpm setting being used when spraying the fluid over the air stream in a similar manner to Type IV fluid air application for anti-icing, and the 60 gpm setting used when the Type III fluid was injected into the air stream to be used for deicing, a practice (injection) not recommended for anti-icing with Type IV fluid, but acceptable after confirmatory testing with Type III fluids.

Fluid Viscosities Chart

Fluid	Lowest On-Wing Viscosity (mPas)	Lowest Acceptable Delivered Fluid Viscosity (mPas) FMC Tempest II		Lowest Acceptable Delivered Fluid Viscosity (mPas) FMC LMD 2000		Lowest Acceptable Delivered Fluid Viscosity (mPas) Global Air Plus	
		With air sleeve	Without air sleeve	With air sleeve	Without air sleeve	With air sleeve	Without air sleeve
Clariant Safewing MP IV 2001	18,000	22,000	22,500	21,000	23,000	Not tested	Not tested
Kilfrost ABC-S	17,000	21,000	21,500	20,500	22,000	Not tested	Not tested
Octagon Max-Flight 04	5,540	8,500	8,500	7,500	7,500	Not tested	Not tested
Clariant Safewing MP IV Launch	7,550	9,000	Not tested	8,500	Not tested	9,500	Not tested
Clariant Safewing MP III 2031 ECO	30	N/A	105	Not tested	Not tested	Not tested	105

Note: Some of the fluids listed are no longer available and are retained here as examples.

Note: Fluids other than those listed here may be applied using forced air if they are tested in a similar fashion

(n) The lowest acceptable delivered viscosity was determined by multiplying the LOWV by the ratio of the fluid viscosity in the tote container divided by the fluid viscosity from the spray sample recovered from the wing, and for Type IV fluids, rounded up to the nearest 500 mPas. Results are in the Fluid Viscosities Chart above:

Note: Use the manufacturer's test viscosity method from Table 6 in the HOT Tables while conducting these or similar tests.

(o) For example, in the table above, Kilfrost ABC S would need to go into the Tempest II tank with a viscosity of at least 21,500 mPas and be sprayed without the air sleeve in place to achieve a LOWV of 17,000 mPas. If the operator preferred to use the air sleeve, the viscosity of the Kilfrost fluid in the tank before spraying would need to be at least 21,000 mPas.

(p) Based on this information, operators using forced air application equipment modified in the same or a near similar manner, especially with regard to reduced air pressure and fluid nozzle spacing above the air stream, as the test vehicles listed, could reasonably expect to apply the listed Type IV fluids at similar lowest acceptable delivered viscosity values and have the fluid on the wing test at a viscosity above the LOWV. Likewise, they may be able to achieve appropriate values for other fluid specific brands, again with the listed or similarly modified equipment, whereby the fluid being sprayed onto aircraft surfaces will be above the LOWV required for that particular fluid specific brand of fluid. These viscosity values must be confirmed by spraying and viscosity testing.

(q) Before using Type IV fluid specific generic HOTs for these Type IV fluids, and similarly for Type II, or III fluids, each operator will need to demonstrate, by spraying and viscosity testing, that its equipment, or equipment operated by other parties to deice the operator's aircraft is capable of applying these fluids without excessive shearing, such that they would no longer meet LOWV requirements.

(r) The FAA strongly recommends that operators avoid getting significantly closer to aircraft surfaces than the 10.5 feet used in the test protocol and that the nozzles be kept at an angle of 45 degrees or less to the surface of the aircraft to avoid excessive fluid shear damage and foaming. Fluid applied by forced air should not contain excessive foam, as evidenced by a frothy, overly foamy, or milky 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).

(s) Also, note that forced air or air/fluid applications may not eliminate the need for conventional fluid deicing and anti-icing for all types of freezing/frozen precipitation.

Note: Except for application equipment and fluids that have been tested as previously described in this section and using fluid of sufficient viscosity to meet LOWV requirements in the air assist mode, published HOT guidelines should not be used when using forced air unless followed by the application of deicing and anti- icing fluid without forced air. Fluids must be applied in accordance with standard application procedures, such as presented in this notice and/or SAE document ARP4737, Aircraft Deicing/Anti-icing Methods.

(t) FADS vary in many respects (e.g., airflow pressure and rate, fluid flow pressure and rate, and optimum effective distance with and without fluid injection). Currently, these factors make it difficult to be specific with procedures without conducting actual tests. Adhere to the usual manufacturer cautions when operating FADS. For example, do not exceed the airframe manufacturer's limits regarding surface temperature and pressure in the air or air/fluid impact areas. The FADS and airframe manufacturer literature should be consulted.

(3) Additional Precautions for FADS.

(a) Ear protection will normally be used and is required when noise levels exceed 85 decibels (dB).

(b) Exercise caution around ground personnel. The potential for blowing ice chunks that 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, vents).
- Blowing snow or slush into landing gear and wheel wells.
- Blowing ice, snow, and slush into aircraft engine inlets, APU inlets, and control surface hinges.

Note: You should obtain information regarding a specific system from its manufacturer's technical literature. The SAE document ARD50102, Forced Air or Forced Air/Fluid Equipment for Removal of Frozen Contaminants, provides information on forced air systems and their usage.

11. Assurance and Control (ACP).

a. Fluid Quality Control (QC).

(1) 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 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 Type 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 invalidate the applicable HOT.

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

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

(3) Checks of fluid quality should be made before the start of the deicing season of all stored fluids. At a minimum, the checks for all fluids, Types I, II, III, and IV, 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.

(4) In addition, for Type II, III, and IV fluids, viscosity checks per the fluid manufacturer's recommendations, (see Table 6 in the HOT Tables) should be performed at the

beginning of the icing season and periodically throughout the winter, and any time fluid contamination or damage is suspected. These viscosity checks include samples obtained through the spray nozzles of application equipment. Viscosity values for dilutions of Type II, III, and IV fluids are included in Table 6, Lowest On-wing Viscosity Values for Anti-icing Fluids, to facilitate fluid viscosity checks in locations where thickened fluids are diluted before applying, and in some cases, may be stored diluted.

(a) 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 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.

(b) 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.

(c) 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 used in the actual anti-icing operation.

12. Fluid Application.

a. Type I Fluid Application Table (Table 1B, located on the FAA Web site). In 2006, a line was added to Table 1B, FAA Guidelines for the Application of SAE Type I Fluid Mixture Minimum Concentrations as a Function of Outside Air Temperature, that states “fluids must only be used at temperatures above their lowest operational use temperature (LOUT).”

(1) The LOUT is the lowest temperature at which a fluid has been determined in a wind tunnel to flow off an aircraft in an aerodynamically acceptable manner while maintaining the required freezing point buffer which is 10° C (18° F) for Type I fluids.

(2) For example, if a Type I fluid is aerodynamically acceptable to -30° C (-22° F), but the freezing point is -35° C (-31° F), the limiting factor (LOUT) would be the freezing point plus the required 10° C (18° F) buffer or -25° C (-13° F). In another example, if a different Type I fluid was aerodynamically acceptable to -30° C (-22° F), and the freezing point was 42° C (44° F) the LOUT would be limited by the aerodynamic performance and the LOUT would be -30° C (-22° F), since the 10° C (18° F) buffer requirement is met at -32° C (-26° F).

(3) At colder temperatures FPD fluids become too thick to flow off the 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.

(4) In 2003, the FAA, in coordination with the SAE G-12 Methods Subcommittee, modified the temperature application requirements for the one-step and the two-step deicing/anti-icing procedures to reflect the requirement for applying heated Type I fluid. The revised note states: “Mix of fluid and water heated to 60º C (140º F) minimum at the nozzle with a freezing point of at least 10º C (18º F) below OAT.” Also, the following note was added: “NOTE: This table is applicable for the use of Type I Holdover Time Guidelines. If holdover

times are not required, a temperature of 60º C (140º F) at the nozzle is desirable.” In essence, this note clarified the requirements for heated Type I fluids mixtures if Type I HOTs are required.

b. Types II, III, and IV Fluids Application Table (Table 5, FAA Guidelines for the Application of SAE Type II, Type III, and Type IV Fluid Mixtures Minimum Concentrations as a Function of Outside Air Temperature, Located on the FAA Web site).

(1) As in Table 1A, the Type I fluid application table, the same note was added in 2006 to Table 5 stating “fluids must only be used at temperatures above their lowest operational use temperature (LOUT).” The only difference is that the freezing point buffer for Type II, III, and IV fluids is 7° C (13° F).

(2) An example of a LOUT for these fluids would be if a specific Type IV fluid is aerodynamically acceptable down to -33° C (-27° F) with a freezing point of -36° C (-33° F), the limiting factor would be the freezing point when the 7° C (13° F) buffer is factored in giving a resulting LOUT of -29° C (-20° F).

(3) In 2005, several changes were incorporated into Table 5. All of these changes, which appear under both the one-step and two-step procedures, were related to the addition of HOTs for dilutions of Type III fluid.

13. Concerns/Conditions.

a. Early Fluid Failure on Extended Slats and Flaps. Research has determined that fluid degradation (via increased flow off) may be accelerated by the steeper angles of the flaps/slats in the takeoff configuration. The degree of potential degradation is significantly affected by the specific aircraft design. Further research is anticipated to characterize the extent of the effect on the HOTs and Allowance Times. The FAA advises all air operators to review their policies and procedures in light of this information to assure appropriate consideration.

b. Aircraft Failure to Rotate when Anti-iced with Type 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 air flow 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 Type IV fluids.

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

c. Possible Effects of Runway Deicer on Thickened Aircraft Anti-icing Fluids.

(1) Most current runway deicing/anti-icing material contains salts that are not compatible with thickened aircraft anti-icing fluids. These salts cause the thickening agents within the aircraft deicing fluids to breakdown, 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.

d. Pretakeoff Contamination Checks. Pretakeoff contamination checks are required to be accomplished within 5 minutes of takeoff after exceeding any maximum HOT in the certificate holder's HOT table.

e. 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.

f. 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 post deicing 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) 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.

g. 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 Type 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 Type 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 Type 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 Type 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 do not flow off the wing during the takeoff ground roll. These accumulations can dry to a gel-like or powdery substance. Such residues can re-hydrate and expand under certain atmospheric conditions such as high humidity or rain. Subsequently, the residues freeze, typically during flight at higher altitudes. Re-hydrated 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 a diluted heated Type II or IV fluid followed by a Type II or IV fluid 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 hot 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 to spray the area with water from a spray bottle and wait 10 minutes.

Residue will re-hydrate 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 build up, 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.

14. Remote On-Ground Ice Detection System (ROGIDS). ROGIDS developments have continued during the past year. These include wide area, remotely mounted (usually on a deicing truck) ice detection systems that use advanced optical technology capable of quickly detecting aircraft contamination from distances up to 100 feet from the aircraft. ROGIDS have shown potential for more efficient and thorough deicing operations. The FAA has performed testing and analysis that has determined that ROGIDS can perform as well as or better than humans both visually and tactilely in detecting ice with a threshold consistent with safety and efficient ground operations in icing conditions. A commercial ROGIDS may come to market during the 2012-13 winter season. SAE Aerospace Standard AS5681 (Minimum Operational Performance Specification for Remote On-Ground Ice Detection Systems (ROGIDS)) and a corresponding AC 120-107, Use of Remote on-Ground Ice Detection System, have been published. When approved as part of a certificate holder's ground deicing and anti-icing program, a certificate holder may use a ROGIDS meeting the requirements of both AS5681 and AC 120-107 as the sole (primary) means of performing the post deicing check for residual clear ice. Certificate holders may also use ROGIDS as a supplemental (advisory) means of performing a pre-deicing check. Certificate holders can only use ROGIDS to supplement other approved means of performing this check, such as visual and/or tactile inspection.

> **Note:** At this time, the FAA has not approved ROGIDS as a primary means for the detection of frost or snow. Therefore, the ROGIDS does not eliminate any requirement for a visual/tactile post deicing inspection for frost or snow.

15. Holdover Time Determination Systems (HOTDS). For a number of years, HOTDS have been in development. These systems convert snowfall data and other types of winter precipitation data into liquid water equivalent (LWE) data which are then used to develop a holdover time. The precipitation rate determined by these devices is matched with holdover time data developed when fluids are tested in natural snow conditions, and artificial conditions for other precipitation types to determine a holdover time 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. The FAA is currently developing an advisory circular describing the approval process for using these devices to determine holdover times.

16. Action.

a. Distribution. 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 the approved HOT guidelines and application procedures attached to this notice. 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 2012-2013 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 spray mode. Also, maintain a safe distance between deicing equipment and aircraft surfaces to avoid contact.

(d) Additionally, cover the entire aircraft surface by the deicing operation 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 Type II, III, and IV fluids, ensure they are applied in the temperature ranges for undiluted or diluted as shown in the holdover tables. If applied according to the respective holdover tables, 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 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) Ground testing the effectiveness of Type II 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 can fall onto cold aircraft wings. Under these conditions, dry snow will swirl as it blows across the wings, making it evident the snow is not adhering. But, if snow has accumulated on the surface of the wings, it has to be removed before takeoff. It cannot be assumed that accumulations of snow will blow off during takeoff.

(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 flight crewmembers) 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. In Canada, a centralized deicing facility has 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 Airborne Communications Addressing and Reporting System (ACARS) datalink 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 indicates that the first fluid failures on test aircraft appear to occur on the leading and/or trailing edges rather than the mid-chord section of the wing. Tests also indicate that fluid failures may be difficult to visually identify. POIs should insure that those aircraft representative surfaces currently included within the air carrier's approved program provide the pilot a proper indication of the status of the aircraft's critical surfaces. Where possible, representative surfaces should:

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

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 fluid. 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 fluid 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 drawn into engines after start up. 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 GIDS have been shown to be very effective in locating ice lodged in the air inlets of turbojet engines.

17. Other Conditions for Which HOTs Do Not Exist (Heavy Ice Pellets, Moderate and Heavy Freezing Rain, and Hail).

a. General. No testing has been conducted in these conditions; therefore, this notice does not provide HOTs or other forms of relief for dispatch in these conditions.

b. Regulations. The regulations clearly state "No person may take off an aircraft when frost, ice, or snow is adhering to the wings…" (§ 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…" (§ 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-ice fluids applied, and ice/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 that previously non-adhering contaminants may adhere to the wing surfaces.

18. Guidelines for Pilot Assessment 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. (For example: 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 holdover/allowance times for the higher intensity or different form of precipitation must be applied. (For example: 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/her own precipitation intensity assessment, he/she will request that a new observation be taken. A pilot must not take action based on his/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. (Example: 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 light 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 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/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 adequate natural sunlight or adequate artificial lighting is available to provide adequate exterior visibility. The snowfall rate chart provided in Table 1C is based on prevailing visibility and allowances are made in the chart for the effects of night light conditions.

(1) Ice Pellets. When ice pellets are being reported, the following chart information extracted from the Federal Meteorological Handbook (FMH 1) 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 holdover/allowance times for the higher intensity or different form of precipitation must be applied.

(3) Snow. The snowfall visibility table attached in Table 1C has previously been published with the annual FAA HOT tables for use in determining snow intensity rates based on prevailing visibility and can be used in place of official reported intensities. Thus the table should be used for pilot assessment of snowfall intensity rates when the actual snowfall intensity is obviously different from that being officially reported or at any other time.

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

(a) All other pilots will be required to be trained on their company's pilot precipitation intensity assessment procedures. 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 Federal Metrological Handbook FMH 1 and Snowfall Intensities as a Function of Prevailing Visibility, Table 1C, 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.

Table 1C. Snowfall Intensities as a Function of Prevailing Visibility

Time of Day	Temp.		Visibility in Statute Miles (Meters)									Snowfall Intensity
	Degrees Celsius	Degrees Fahrenheit	≥ 2 1/2 (≥ 4000)	2 (3200)	1 3/4 (2800)	1 1/2 (2400)	1 1/4 (2000)	1 (1600)	3/4 (1200)	1/2 (800)	≤ 1/4 (≤ 400)	
Day	colder/equal -1	colder/equal 30	Very Light	Very Light	Very Light	Light	Light	Light	Moderate	Moderate	**Heavy**	
	warmer than -1	warmer than 30	Very Light	Light	Light	Light	Light	Moderate	Moderate	**Heavy**	**Heavy**	
Night	colder/equal -1	colder/equal 30	Very Light	Light	Light	Moderate	Moderate	Moderate	Moderate	**Heavy**	**Heavy**	
	warmer than -1	warmer than 30	Very Light	Light	Moderate	Moderate	Moderate	Moderate	**Heavy**	**Heavy**	**Heavy**	

NOTE 1: This table is for estimating snowfall intensity. It is based upon the technical report, "The Estimation of Snowfall Rate Using Visibility," Rasmussen, et al., Journal of Applied Meteorology, October 1999 and additional in situ data.

NOTE 2: This table is to be used with Type I, II, III, and IV fluid guidelines.

NOTE 3: If visibility from a source other than the METAR is used, round to the nearest visibility in the table, rounding down if it is right in between two values. For example, .6 and .625 (5/8) would both be rounded to .5 (1/2).

HEAVY = Caution—No Holdover Time Guidelines Exist

Note: During snow conditions alone, the use of Table 1C in determining snowfall intensities does not require pilot company coordination or company reporting procedures since this table is more conservative than the visibility table used by official weather observers in determining snowfall intensities.

Note: Because the FAA Snow Intensity Table, like the FMH 1 Table, uses visibility to determine snowfall intensities, and if the visibility is being reduced by snow along with other forms of obscuration such as fog, haze, smoke, etc., the FAA Snow Intensity Table does not need to be used to estimate the snow fall intensity for HOT determination. Use of the FAA Snow Intensity Table under these conditions may needlessly overestimate the actual snowfall intensity and therefore the snowfall intensity being reported by the weather observer or automated service observing system (ASOS), from the FMH 1 Table may be used.

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

a. All other pilots will be required to be trained on their company's pilot precipitation intensity assessment procedures. 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 Federal Metrological Handbook FMH 1 and Snowfall Intensities as a Function of Prevailing Visibility, Table 1C, 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.

20. Program Tracking and Reporting Subsystem (PTRS) Input. POIs must make a PTRS entry to record the actions directed by this notice with each of their operators. List the PTRS entry as "1381" and enter it into the "National Use" field as "N8900.196" (no quotes or punctuation). POIs should use the comments section to record comments of interaction with the operators.

21. Air Transportation Oversight System (ATOS) Action. Within 30 days of receiving this notice, POIs will ensure that the Director of Safety (DOS) of his or her assigned air carrier is aware of it.

a. Recommendations. The POI must assess the air carrier's response to the recommendation. An air carrier's failure to implement these recommendations into its existing program could result in an increase in risk in several areas.

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 Safety Attribute Inspections (SAI) or Element Performance Inspections (EPI), convening a System Analysis Team (SAT), or re-evaluating air carrier approvals or programs.

22. ATOS Reporting. POIs will make an ATOS entry using the “Other Observation DOR” functionality to record the actions directed by this notice. The POI will access the “Create DOR” option on their ATOS homepage, select the “Other Observation” tab, and:

- Select System: 3.0 Flight Operations.
- Select Subsystem: 3.1 Air Carrier Programs and Procedures.
- Select the appropriate air carrier from the drop down menu.
- Select “1381” from the “PTRS Activity Number” drop down menu.
- Enter the date the activity was started and completed.
- Enter the location where the activity was performed.
- Enter “N8900xxx” in the “Local/Regional/National Use” field.
- Use the “Comments” field to record any comments reflecting interaction with the air carrier and the air carrier’s response to the recommendation.
- Input any actions taken in the “Reporting Inspector Action Taken” field.
- Select the “Save” button after all entries have been made.

23. Disposition. We will incorporate the information in this notice into FAA Order 8900.1 before this notice expires. Direct questions concerning this notice to the Air Carrier Operations Branch, (AFS 220) at 202-493-1422.

for

John M. Allen
Director, Flight Standards Service