NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

N 8900.55

National Policy

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10/30/08

Cancellation Date:
10/30/09

SUBJ: FAA-Approved Deicing Program Updates, Winter 2008-2009

1. Purpose of This Notice. This notice provides inspectors with information on holdover times (HOT), a listing of qualified 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 branches and divisions in the regions and in headquarters.

3. Where You Can Find This Notice. Inspectors can access this notice through the Flight Standards Information Management System (FSIMS) at http://www.fsims.avs.faa.gov. Operators and the public can find this notice at http://fsims.faa.gov.

4. Cancellation. This notice cancels Notice N 8900.22, FAA-Approved Deicing Program Updates, Winter 2007-2008, dated October 12, 2007.

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, unless the certificate holder complies 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. Part 125, § 125.221, and part 135, § 135.227(b)(3), allow both kinds of certificate holders to comply with a part 121 approved program.

a. Types I, II, III, and IV fluid HOT guidelines for fluids that meet the Society of Automotive Engineers (SAE) Aircraft Deicing/Anti-icing Fluid Specifications AMS 1424 (Type I), and AMS 1428 (Types II, III, and IV) and associated guidelines for the application of these deicing/anti-icing fluid mixtures.

(1) In 2003, the Federal Aviation Administration (FAA) revised the HOT guidelines to reflect new test results for heated Type I fluids and expanded the visibility tables associated with Type I HOT guidelines to accommodate very light snow conditions. These tables are not changed for winter 2008-2009.

(2) In 2005, the “above 0 degrees Celsius/above 32 degrees Fahrenheit” temperature band was removed from generic and brand name specific Types II and IV HOT tables due to the difficulty in getting HOT data in outdoor snow conditions above freezing. As a result of this change, a footnote was added to the Rain on Cold Soaked Wing column stating that this column was for use at temperatures above 0 ºC (32 ºF).

(3) One new Type II fluid, Kilfrost ABC-K Plus, has been added to the list of qualified Type II fluids. The addition of this new fluid did not change any of the values in the cells in Table 2, the generic Type II fluid HOT table. Aviation Xi’an High-Tech KHF-II, which was added to the list of qualified fluids in 2007 was removed due to fluid specification concerns. Specifically, there may still be batches of the fluid on the market that were shipped/delivered with viscosities lower than the published lowest on-wing viscosity (LOWV) for use with the HOT guidelines. More recently, Aviation Xi’an High Tech indicated to the FAA that they were going to requalify the fluid at a higher viscosity. The FAA has requested the new aerodynamic testing results, but these have not been provided by Aviation Xi’an.

(4) No new Type IV fluids were added for 2008-09. The removal of obsolete data in the cold soaked wing cells resulted in increases to these HOT values in Table 4, the generic Type IV fluid HOT table, which represents the worst case for all the Type IV fluid HOTs combined.

b. A listing of qualified Types I, II, III, and IV deicing/anti-icing fluids for the 2008-2009 winter icing season, including updated information.

c. Review of various other ground deicing/anti-icing historical changes.

Note: The SAE no longer publishes HOT guidelines. The FAA, in coordination with Transport Canada (TC) and the SAE G-12 Aircraft Ground Deicing Holdover Time Subcommittee generated the HOT guidelines published in this notice. Test results from an independent testing laboratory and data analysis procedures endorsed by the subcommittee were used to generate the HOT guidelines.

(1) In 2006 allowance time guidance was added to this document for operations in light ice pellets with no other forms of precipitation present. Also in 2006 guidance for operations in heavy snow was provided.

(2) In 2007 additional allowance times for ice pellet operations were made available based on extensive research conducted during the winter of 2006-2007. These additional allowance times extend to moderate ice pellets and ice pellets mixed with other forms of precipitation as well as addressing the aging of anti-icing fluid with embedded ice pellets after the precipitation stops. Additionally, guidelines for operators to develop procedures for pilot assessment of precipitation intensities were added in 2007. The ice pellet allowance times and pilot assessment guidelines remain unchanged for 2008-09.

6. Discussion.

a. HOT Guidelines.

(1) Contents.

(a) Appendix 1 tables include FAA-approved HOT guidelines for SAE Types I, II, III, and IV fluids, as well as FAA-approved SAE guidelines for the application of these fluids. Type III fluid exhibits times typically less than those of Type II and Type IV fluids, but significantly longer than those of Type I fluids. Also, because of the difference in performance of specific Types II and IV deicing/anti-icing fluids available, the FAA has also included 8 Type II and 13 Type IV manufacturer-specific HOT guidelines. The manufacturer-specific Types II and IV HOT guidelines are as follows:

MANUFACTURER SPECIFIC TYPE II FLUIDS	**MANUFACTURER SPECIFIC TYPE IV FLUIDS**
ABAX (SPCA) Ecowing 26	ABAX (SPCA) AD-480
Clariant Safewing MP II 2025 ECO	Clariant Safewing MP IV 2001
Clariant Safewing MP II Flight	Clariant Safewing MP IV Launch
Kilfrost ABC-II PLUS	Clariant Safewing MP IV 2012 Protect
Kilfrost ABC-2000	Dow UCAR Ultra+
Kilfrost ABC-K PLUS	Dow UCAR Endurance EG106
Newave Aerochemical FCY-2	Dow UCAR Flightguard AD-480
Octagon E-MAX	Kilfrost ABC-S
	Kilfrost ABC-S Plus
	Lyondell ARCTIC Shield
	Octagon Max-Flight
	Octagon Max-Flight 04
	Octagon MaxFlo

(b) The FAA Type II (Table 2) and Type IV (Table 4) 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 manufacturer-specific HOT guidelines (Tables 2A-2G and Tables 4A-4N) 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 HOTs from Table 2 or 4, as appropriate.

(c) Also included (Table 7) is a list, by manufacturer brand name, of qualified Types I, II, III, and IV deicing/anti-icing fluids.

(d) Table 1B, which relates various snowfall intensities to prevailing visibilities, was expanded in 2003 to encompass very light snow conditions. To facilitate the use of Table 1B with Table 1, the Type I HOT guidelines, and Table 3, the Type III HOT guidelines, color-coding was added. The color-coding is as follows:

Very Light Snow	**Light Green**
Light Snow	**Light Yellow**
Moderate Snow	**Gold**
Heavy Snow	**Red**

Table 1B may also be used in estimating snow intensities for use with Types II, III and IV Fluid HOT guidelines.

(e) Although the meteorological approach to estimating snowfall rate has been based upon visibility, the HOTs of any anti-icing fluid are directly related to the amount of moisture (liquid equivalent snowfall) it can absorb prior to freezing. The snow intensities of Table 1B are based on investigations conducted by the National Center for Atmospheric Research (NCAR) and APS Aviation of Montreal, Canada. During the 1995-2002 winter icing seasons, more than 7,000 observations of prevailing visibilities in snow, with liquid equivalent snowfall rates, for various temperature and day/night conditions, were recorded. These observations reveal that a combined visibility/temperature pair is required for a more accurate determination of snowfall intensities and form the basis for the revised Table 1B. This table is essential for proper estimation of snowfall intensities, which are essential for determining liquid equivalent snowfall rates.

Note: The SNOW INTENSITY values of Table 1B were originally developed to use in conjunction with Table 1 for determining FAA Type I Fluid HOT guidelines for SNOW. However, Table 1B works equally well when used to estimate HOTs for snow columns of FAA Type II, III, and IV fluids and may also be used with these fluids.

(2) Type I HOT Guidelines.

(a) The Type I HOT guidelines (Table 1) remain unchanged for the upcoming 2008-2009 winter icing season.

(b) The Type I HOT values of the guidelines primarily are based on SAE-revised test methodologies to accommodate the effects of applying HEATED Type I fluids in determining their time of effectiveness for the various freezing precipitation conditions.

1. Prior to the 2002-2003 winter icing season, Type I HOT values had been determined based on the application of unheated fluids. Recent findings indicate that the time of protection provided by Type I fluid (unlike Types II, III, and IV) is directly related to the heat input to aircraft surfaces.

2. Type I fluid dilutes rapidly under precipitation conditions; however, the heat absorbed by the aircraft surfaces will tend to keep the temperature of the diluted fluid above its freezing point for a limited time. 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.

3. 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.

(c) 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, 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.

1. Previously, SNOW HOT guideline values were based on the then-current moderate snow conditions and a liquid equivalent snowfall rate of 1.0 to 2.54 mm/hr (0.04 to 0.10 in/hr of liquid equivalent snowfall). The SAE G-12 HOT Subcommittee had defined light snow as a snowfall rate of less than 1.0 mm/hr (less than 0.04 in/hr of liquid equivalent snowfall).

2. During the meeting of the SAE G-12 HOT Subcommittee in May 2003, values between 0.2 and 0.4 mm/hr were recommended for very light snow conditions. Thus, in the current FAA Type I HOT guideline, HOT values for liquid equivalent snowfall rates between 0.4 and 1.0 mm/hr (0.016 to 0.04 in/hr) are selected for the light snow column and HOT values for liquid equivalent snowfall rates between 0.2 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; and
- Possible safety concerns associated with pretakeoff checks.

(d) During the 2001-2002 winter icing period, more than 250 tests using heated Type I fluids in natural snow were conducted. These tests used an insulated thermal equivalent 7.5 cm test box to simulate the thermal response of the leading edge of an aircraft wing instead of the standard uninsulated frosticator plate used in prior years. Extensive laboratory and field tests had determined that the insulated 7.5 cm test box more closely matched the thermal response of an aircraft wing leading edge than the frosticator plate. During the tests, fluids were diluted to a 10 ºC (18 °F) buffer and applied at 60 ºC (140 ºF) to the 7.5 cm insulated thermal equivalent test box. HOT results from these tests were deemed to more closely coincide with those observed during actual deicing operations in snow conditions.

(e) Note that in Table 1 there are double diamonds in the snow columns (Very Light Snow◆◆, Light Snow◆◆, and Moderate Snow◆◆) with an accompanying note. The note states, **"TO USE THESE TIMES, THE FLUID MUST BE HEATED TO A MINIMUM TEMPERATURE OF 60 ºC (140 ºF) AT THE NOZZLE AND AT LEAST 1 LITER/M^2 (≈ 2 GALS/100FT^2) MUST BE APPLIED TO DEICED SURFACES."**

1. 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.

2. When establishing compliance with the temperature requirement of 60 ºC (140 ºF) at the nozzle, 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 10 ºC (18 °F) or less. Some manufacturers producing equipment that uses instant-on heat or last bypass heaters have indicated a temperature drop of 5 ºC (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 ºC (140 ºF) at the nozzle is sufficient.

(f) Frozen contamination removal is the deicing step of a deicing/anti-icing procedure. It is emphasized that the use of HOT guidelines requires that an anti-icing step be performed. The Type I HOT guideline also provides an estimate of the time of protection under precipitation conditions. The double diamonds note on the Type I HOT guidelines specifies the quantity of fluid that must be applied over and above that required to deice (i.e., the anti-icing step).

Note: HOTs start as soon as the anti-icing step begins. Users who rely on the one-step procedure (Table 1A) cannot assume that terminating the operation, after the frozen contamination has been removed, conforms to the intent of this table.

(g) The note further states that heated Type I fluid must be applied to a "DEICED" surface, meaning that this is the anti-icing step. The minimum quantity stated in this note, "AT LEAST 1 LITER per square meter (approximately 2 gallons per 100 square feet)," serves as a guide. This minimum quantity will vary depending on the aircraft, fluid application equipment, crew technique and experience, outside air temperature (OAT), and fluid spray pattern. Larger aircraft with greater skin thickness and more massive internal structure may require quantities greater than 1 liter/m^2. The FAA does not intend for air carriers to measure this fluid quantity during the anti-icing step. For anti-icing, a moderate amount of Type I applied to drive off all fluids that have absorbed snow, ice, and slush during the deicing process has proven to be a safe practice. Experience with a particular aircraft can serve as the primary guide as to which surfaces are prone to fail first (e.g., wing tips, control surfaces, structurally thin areas, etc.). Such areas should receive adequate coverage of Type I fluid.

b. Interpretation of HOT Guidelines. The FAA intends for HOT guidelines to provide an indication of the APPROXIMATE length of time that a freezing point depressant (FPD) fluid will protect aircraft surfaces during icing conditions and while on the ground. FPD fluids do not provide icing protection while airborne. Tables 2 and 4 represent the generic or worst-case tables. Of all fluids tested for each Type II and Type IV fluid, the FAA has entered the lowest HOT value in each cell for each precipitation condition. Therefore, for any brand of fluid, its HOT will be as good as or better than the value in the appropriate worst case chart. This can be important if the brand of fluid is not known. In 2005 HOTs for dilutions of Type III fluid were added. Previously, the necessary data was not available. Some manufacturers of Types II and IV fluids have concurred in the publication of HOT guidelines for their particular fluid(s). These are termed “brand specific” HOT guidelines. They are listed in:

- Tables 2A through 2H (for Type II fluids); and
- Tables 4A through 4M (for Type IV fluids).

(1) The HOTs for Type II, Type III, and Type IV fluids are primarily a function of the OAT, precipitation type and intensity, and percent FPD 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 HOT. Snow testing is conducted outdoors and may or may not involve varying winds. This can have varying effects on the test results.

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

(3) For Type I fluid (Table 1), note the statement in the commentary under that reads, “... freezing point of the mixture is at least 10 ºC (18 ºF) 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 10 ºC (18 ºF), which you can interpret as the FREEZING POINT of the fluid being 10 ºC (18 ºF) below the outside air temperature. The 10 ºC (18 ºF) 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; and
- Solar radiation.

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

(a) Under the Degrees Celsius column, below -3 ºC to -6 ºC for FREEZING DRIZZLE, the HOT is 0:05-0:09, 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; and
- As long as 9 minutes for light freezing drizzle conditions.

(b) In all cells of Table 1, 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 0.2 mm to 0.4 mm/hr and for light snow is 0.4 mm to 1.0 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, snow pellets, 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 which are contained in this notice. Additionally, takeoff in heavy snow may be accomplished if the requirements for operating in this condition, as provided in this notice, are met.

(c) The FAA also emphasizes that air carriers should read and understand all notes and cautions, such as the reference to the 10 ºC (18 ºF) buffer, in the guidelines to preclude improper usage of the fluid. The caution notes are important to manufacturers’ specific tables because unique characteristics of a particular brand of fluid may warrant cautions not found in the generic or worst-case guidelines.

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

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

- Type I fluids are applied to maintain at least a 10 ºC (18 °F) buffer between the OAT and the FREEZING POINT of the fluid/water mix; and
- 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 10 ºC (18 ºF) buffer for Type I fluids and the appropriate fluid/water concentration (100/0, 75/25, or 50/50) for Type II, Type III, and Type 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 60 ºC (140 ºF) at the nozzle and applied at a rate of at least 1 LITER/M^2 (approximately 2 gals/100 ft^2).

(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. Type III fluid is relatively new to the market and can also be used heated and diluted now that 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 Types II and IV fluids in the one-step procedure, questions have arisen regarding the anticipated HOT performance of these fluids.

1. 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.

2. Some air carriers proposed using the Type I HOT guideline values instead of Types II and IV values when these thickened, heated fluids were applied. Another carrier suggested reducing the Types II and IV HOT values by a factor of 50 percent. During tests conducted by APS Aviation for the FAA and TC using 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, 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 Types II and IV fluids or using the Type I fluid HOT guidelines when heated Types II and IV fluids are properly applied.

3. In addition, HOT guideline data was obtained for the newly introduced 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.

(e) 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 Types 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 to begin with.

(5) Tables dealing with Type II, and Type 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. Furthermore, when testing in the laboratory for frost, only one precipitation condition is considered rather than a range. Thus, there is no range in HOT for frost. 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.

Note: HOTs for frost are for ACTIVE frost conditions.

(7) A note appears at the bottom of the Types II, III, and IV HOT guideline tables pertaining to the OAT and FREEZING POINT of the fluid and their relationship to the fluid’s aerodynamic performance. The user should obtain the Lowest Operational Use Temperature (LOUT) of the fluid from the manufacturer, which is based on its aerodynamic performance (i.e., the fluid’s ability to flow off the wing during takeoff in extreme cold conditions) and the fluid’s freezing point depression capabilities.

c. Holdover Time Guidelines Overview.

(1) The FAA has constructed generic HOT guidelines for Types I, II, III, and IV fluids (Tables 1, 2, 3, and 4, respectively) to present information on the minimum performance times that have been observed during testing of these deicing/anti-icing fluids.

(2) Typically, each cell of the HOT values represents a range of performance times in which the fluid provides acceptable protection for varying precipitation intensities for the following conditions:

- Freezing fog,
- Snow,
- Freezing drizzle,
- Light freezing rain,
- Rain on cold-soaked wings.

Note: Except for the light snow, very light snow, and light freezing rain conditions, the lower HOT value in a cell presents information for moderate precipitation conditions. For freezing drizzle conditions the range covers all ranges of precipitation intensities, including heavy. The longer HOT value is representative of fluid performance for light precipitation conditions. HOT values for heavy precipitation conditions (except freezing drizzle) do not exist.

(3) For Type I HOT guidelines, testing was conducted at -3 °C (27 °F) and applied to the above -3 °C (27 °F) range. The FAA deemed potential differences between 0 °C (32 °F) and -3 °C (27 °F) HOT values for Type I fluid as insignificant because thermal energy is a key factor in achieving HOT performance for Type I fluid.

d. Unique Holdover Time Guidelines.

(1) In the manufacturer's specific Type IV HOT guidelines for Octagon Max-Flight (Table 4D), in some cells protection is increased when fluid concentration is reduced. Under the SNOW, FREEZING DRIZZLE, and LIGHT FREEZING RAIN columns, the 75/25 concentration provides a moderate increase in protection over the 100/0 concentration. The addition of certain quantities of water to some neat fluids can enhance their performance up to a certain point. For example, when water is added to Octagon Max-Flight, it allows the fluid to build up thicker on surfaces, due to an increase in viscosity. During HOT testing, neat Octagon Max-Flight Type IV fluid typically exhibited a thickness of 0.7 mm on the test surface. When neat Max-Flight Type IV fluid was diluted with water to a 75/25 mix, the mix typically exhibited a thickness of 1.4 mm. Some of the tabular data for the Max-Flight Type IV fluid indicates this effect. Without knowing about this particular fluid mix phenomenon, an air carrier may think that the data presented in the tables is in error.

(2) Similar performance contradictions were observed (i.e., the 75/25 concentrations exceeded those of 100/0 concentrations) for the following Type II fluids in FREEZING FOG conditions:

- Kilfrost ABC-II Plus (Table 2E), and
- Kilfrost ABC-2000 (Table 2D).

(3) One Type IV fluid, Octagon Max Flight 04, has a HOT of 2:00-2:00 in light freezing rain in the -3 ºC and above cell. This is due to the fact that this fluid demonstrated a HOT of at least two hours at the lower and higher precipitation rates for this condition. By convention HOT are limited to two hours for all precipitation conditions tested except freezing fog and frost. As new fluids become available this same phenomenon could be observed again in the same or different cells.

(4) Other unique fluids are the Type IV Dow UCAR Ultra+ (Table 4E), and Dow UCAR Endurance EG106 (Table 4F). There are no HOT values for these fluids in the 75/25 and 50/50 concentrations.

e. Snowfall Intensity-Visibility Table. Table 1B presents critical information on the variability of snowfall intensities as a function of prevailing visibilities. The HOT of any anti-icing fluid is directly related to the amount of moisture it can absorb before freezing. Currently, snow intensities reported by the National Weather Service do not take into account the effect of temperature on snow moisture content.

(1) Snowflake density is a key factor in determining the moisture content of snow. Wet snow, which generally occurs at temperatures above -1 ºC (30 °F), has a greater density than dry snow. Also, being heavier, it will fall at a higher velocity than dry snow. Thus, for a given visibility, these two factors will cause wet snow to deposit more moisture than dry snow. Table 1B presents temperature correlation information, which more accurately relates wet snow and dry snow intensities to visibilities.

(2) During night snowfall, the visibility is about twice as good as it is during the day for the same snowfall rate. This occurs because snow reflects light at a high rate and, during the day, light comes from all directions, which makes the reflections worse. At night, there is less light and light rays are more directed toward you with reduced glare and reflections. Therefore, Table 1B also presents a differentiation between day and night conditions to make visibility a more accurate indicator of moisture content for a given snowfall intensity and temperature. Therefore, you must consult Table 1B for an accurate estimation of snowfall intensity moisture content (liquid equivalent snowfall rate), which is based on prevailing visibility and temperature.

7. Revisions.

a. Holdover Time Changes.

(1) The HOTs for Type I fluids remain unchanged from those of the 2007-2008 winter icing season version.

(2) The “above 0 degrees Celsius/above 32 degrees Fahrenheit” temperature band was removed in 2005 from generic and brand name specific HOT tables due to the difficulty in getting HOT data in outdoor snow conditions above freezing. A footnote was added in 2005 to the Rain on Cold Soaked Wing column stating that this column was for use at temperatures above 0 ºC (32 ºF). Values in the Type II generic HOT guideline for other temperatures have not changed, since the two new Type II fluids introduced did not shorten the generic times, nor were there any that had been removed due to non-production/non-availability for the required period of 4 years.

(3) A Type III fluid, Clariant MP III 2031 ECO, was introduced for the 2004-2005 winter icing season with a corresponding generic HOT guideline for undiluted fluid only. In 2005, HOT values were developed for dilutions (Table 3). Type III fluid is designed to accommodate aircraft with low rotation/takeoff speeds, although it works equally well on aircraft with higher rotation/takeoff speeds and offers substantial improvements in anti-icing performance when compared to Type I fluid. Also, it does not require specialized low shear application and transfer equipment. This particular fluid was designed to be used in Type I storage tanks and application equipment, either diluted or undiluted for deicing and for anti-icing. Type III fluids can be applied heated or unheated for anti-icing.

(4) Like the HOTs for Type II fluids, the “above 0 degrees Celsius/above 32 degrees Fahrenheit” temperature band was removed in 2005 on Type IV tables due to the difficulty in

getting HOT data in outdoor snow conditions above freezing. A footnote was added to the Rain on Cold Soaked Wing column stating that this column was for use at temperatures above 0 ºC (32 ºF). The values of the Type IV generic HOT guideline did not change in 2005 as the addition of one new fluid did not shorten any of the generic times. A Type IV fluid was deleted this year due to being out of production, or not available for 4 years, and therefore no changes were attributable to deletions.

(5) In 2005, the viscosity and measurement criteria were moved from the top of each manufacturer's specific Types II and IV HOT tables to Table 6 in the Appendix. These viscosity values are the LOWV at which the fluid can reasonably be expected to provide HOTs consistent with those in the manufacturer's specific (brand name) HOT guidelines. They are for the user's information and not anticipated to be used by, or made available to, flightcrews. However, users should periodically verify that their fluid meets this published viscosity.

(6) For 2008-09 the introduction of one new Type II fluid did not cause any changes to Table II which contains the generic HOTs for Type II fluids. Removal of obsolete Type IV data has resulted in increases to the values in the cold soaked wing cells of Table IV, the generic Type IV HOT table.

Note: "Radiational cooling during active frost conditions may reduce HOTs when operating close to the lower end of the outside air temperature range." was added to the Type II, and Type IV HOT tables. This information was placed on the tables to reflect concerns regarding recent FAA and TC research showing, in some cases, a significant temperature difference between the OAT and the aircraft surface temperature with the aircraft surface being colder. Initial research showed that in this condition the HOT could be reduced. Frost research related to this phenomenon is continuing, but until more information becomes available, operators should be aware of the potential for the wing temperature to be colder and the potential effect on reducing HOTs.

b. Table 1A-Type I Fluid Application Table.

(1) In 2006 a line was added to Table 5 stating that "fluids must be used at temperatures above their lowest operational use temperature."

(2) 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.

(3) 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).

(4) 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).

(5) Basically 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.

(6) 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: **"Mixture of fluid and water heated to 60 ºC (140 ºF) minimum at the nozzle with a freezing point of at least 10 ºC (18 ºF) below OAT."** Also, the following note was added: **"NOTE: This table is applicable for the use of Type I Holdover Time Guidelines. If HOTs are not required, a temperature of 60 ºC (140 ºF) at the nozzle is desirable."** In essence, this note clarified the requirements for heated Type I fluids mixtures if Type I HOTs are required.

c. Table 5. Types II, III, and IV Fluids Application Table.

(1) As in Table 1A, the Type I fluid application table, the same note was added in 2006 to Table 5 stating "fluids must be used at temperatures above their lowest operational use temperature." The only difference is that the Freezing point buffer for Types 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, "FAA Guidelines for the Application of SAE Types II, III, and IV Fluid Mixtures." All of these changes, which appear under both the one-step procedure and the two-step procedure, were related to the addition of HOTs for dilutions of Type III fluid.

d. Table 7. List of Qualified Deicing/Anti-icing Fluids - Winter 2008-2009. Several new Type I fluids have been added. A new Type II fluid, Kilfrost ABC-K Plus was added. Aviation Xi'an High-Tech KHF-II, which was added to the list of qualified fluids in 2007 was removed due to fluid specification concerns. Specifically, there may still be batches of the fluid on the market that were shipped/delivered with viscosities lower than the published LOWV for use with the HOT guidelines. More recently, Aviation Xi'an High Tech indicated to the FAA that they were going to requalify the fluid at a higher viscosity; the FAA requested the new aerodynamic testing results, however these have not been provided by Aviation Xi'an.

8. Other Concerns/Conditions.

a. 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 those single-engine high wing turboprop 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, since 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 so as 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.

b. Tactile Inspection of Hard Wing Airplanes (No Leading Edge Devices/Slats). 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 five minutes prior to takeoff must be accomplished through a visual and tactile check of the critical surfaces.

c. Anti-icing Quality Assurance. Operators must ensure that that sufficient anti-icing fluid is applied to remove/replace remaining deicing fluid. Anytime orange color from Type I fluid can be seen mixed with the green color from Type IV fluid, the Type I fluid was not adequately removed from the aircraft surfaces when the Type IV fluid was being applied. Also it is critically important to completely cover the aircraft critical surfaces with a coating of Type IV fluid (the thickness of the anti-icing fluid should be approximately the thickness of a U.S. dime). The anti-icing protective coating must completely cover and be running over the front of the wing leading edges as well as a uniform coating over all the critical surfaces. Operators are required to monitor their own and contract deicing anti-icing applications to confirm that fluids are being applied properly.

d. Fluid Quality Control.

(1) Prolonged or repeated heating of fluids may result in loss of water content, which can lead to performance degradation of the fluid. De/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 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 invalidates the applicable HOT.

(2) Other types of fluid degradation may result from chemical contamination or in the case of Types II and Type 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 prior to 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 Types II, III, and IV fluids, viscosity checks, per the fluid manufacturer's recommendations, 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 should be performed in accordance with fluid manufacturers' recommendations and should include samples obtained through the spray nozzles of application equipment. Viscosity values for dilutions of Types II, III, and IV fluids have been added to Table 6 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, non-metallic 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.

e. 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 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 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 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 hinge areas. This especially can be a problem with non-powered 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 Types II or IV fluid and 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 Types II or IV fluids are used exclusively to de/anti-ice their aircraft. If an operator suspects residue as a result of fluid dry-out, one acceptable procedure is for the operator 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 de/anti-icing procedures likely to result in dehydrated fluid build up, aircraft cleaning in accordance with the aircraft manufacturers' recommendations, should be conducted. This cleaning should be accomplished with hot Type I fluid and/or water mix, or other aircraft manufacturer recommended cleaning agent. These cleaning procedures may require subsequent lubrication of affected areas. If evidence of fluid dry-out is present a increase in the frequency of inspection of flight control bays and actuators may be necessary.

f. 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.

g. Frost. Several inquiries have been made relative to active frost. Active frost is a frost condition demonstrating actively growing crystals that gain in mass and thickness. It typically forms at night under clear skies and calm winds when the OAT is below 0 ºC and the dew point temperature spread is less than 3 ºC. The temperature of the aircraft surface must be below 0 ºC. As an example, if an aircraft is parked outdoors on a cold, clear night, heat can radiate from its surface at a rate greater than is absorbed from its surroundings. The net effect is that the aircraft surface temperature drops below the OAT. If this temperature is below the frost point temperature of the air, moisture will deposit in the form of hoarfrost.

(1) As a guide, if there is frost on any object in the deicing area (including the aircraft) and the OAT and dew point are 3 ºC apart and narrowing, there is likely to be active frost. If the OAT and dew point are 3 ºC apart and expanding, it is not clear if there is active frost. Therefore, if there is doubt, treat the condition as active frost. Weather forecasts and Aviation Routine Weather Reports (METAR) usually do not provide information on frost conditions.

(2) Thin hoarfrost is acceptable on the upper surface of the aircraft fuselage if all vents and ports are clear. This hoarfrost is usually a uniform white deposit of fine crystalline texture, as indicated above, and is thin enough for observers to visually distinguish aircraft paint surface features underneath it, such as paint lines, markings, and lettering.

9. New Technology.

a. Gas-Fired Infrared Systems.

(1) A gas-fired infrared (IR) system contained in a modular shelter facility is in operation at several airports, including Newark International Airport (EWR) and John F. Kennedy International Airport (JFK). 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. This system was originally used to deice commuter and moderate size aircraft (e.g., B-737), but some newer installations are capable of deicing much larger aircraft.

(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 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 for use 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 0 ºC (32 ºF)), 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 de/anti-icing fluid from aircraft surfaces.

b. Mobile Infrared Systems. A mobile IR deicing system that melts frozen contaminants from exposed aircraft surfaces continues to be developed. This system consists of a moveable, boom-mounted heating panel installed on a truck. Temperature-controlled flameless catalytic heaters fueled by natural or propane gas generate the IR heat. During operations, these heater panels are normally situated several feet from the aircraft surfaces and use temperature sensors to measure aircraft surface temperatures. This system was used in the United States Air Force (USAF)-sponsored Aircraft Ground Deicing Evaluation exercise, conducted at the USAF Eglin Air Force Base (AFB) McKinley Cold Chamber in the spring of 2002. The FAA anticipates that these units will usually be employed in pairs (or more).

c. Forced Air Deicing Systems.

(1) Overview. The military and foreign air carriers have used Forced Air Deicing Systems (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, or
- 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. Generally, this mode is not as effective as the application of Type I 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 Types 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 Types 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.

1. 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.

2. 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, and
- Fluid brand: Clariant Safewing MP-IV 2001.

3. 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. Prior to 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; and
- Test wing employing forced air-assist application.

4. Results were mixed. Shearing in four of the six fluids tested produced viscosities below acceptable LOWVs 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. However, 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.

5. Additional anti-icing fluids employing forced air delivery systems that have been optimized for anti-icing applications (i.e., 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.

6. 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; and
- The forced air delivery pressure was decreased from 13 psi to 6 psi.

7. 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 prior to spraying and from the surface of a Lockheed Jet Star wing used as a spray target. All tote and wing samples were centrifuged prior to 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 prior to exiting the nozzle and produces a less turbulent airflow.

8. 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, seven inches between the air and fluid nozzles centerlines on the FMC trucks, eight 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.

9. 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 and 60 gallons per minute 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 60gpm 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	**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 Safwing 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

10. 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 were as follows:

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

11. 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 prior to spraying would need to be at least 21,000 mPas.

12. 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 brands, again with the listed or similarly modified equipment, whereby the fluid being sprayed onto aircraft surfaces will be above the lowest on wing viscosity required for that particular brand of fluid. These viscosity values must be confirmed by spraying and viscosity testing.

13. Prior to using Type IV brand name or 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.

14. 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).

15. 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.

(e) 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 striking ground personnel and the restriction to 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 well areas; and
- Blowing ice, snow, and slush into aircraft engine inlets, APU inlets, and control surface hinge areas.

Note: You should obtain information regarding a specific system from its manufacturer's technical literature. The SAE document ARD 50102, "Forced Air or Forced Air/Fluid Equipment for Removal of Frozen Contaminants," provides information on forced air systems and their usage.

d. Non-Glycol Based Deicing/Anti-icing Fluids. In recent years, new non-glycol-based Type I deicing/anti-icing fluid have been qualified to the requirements of AMS-1424. These fluids, based upon glucose-lactate combinations and other formulations, successfully completed qualification tests and were considered to be environmentally benign when compared to glycol-based deicers. One of these fluids, Metss ADF-2, was a slightly different formulation of the earlier non-glycol-based Metss ADF fluid. The USAF undertook initial use of the Metss fluid in 2003; however, results were unfavorable. Consequently, the USAF withdrew this fluid from service, citing undesirable stickiness and tackiness of residual fluids. Therefore, the METSS ADF-2 Type I fluid was removed from the FAA qualified fluids list for 2004-2005.

e. Ground Ice Detection System. Ground Ice Detection System (GIDS) 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. GIDS have shown potential for more efficient and thorough deicing operations; the FAA is currently sponsoring testing and analysis to determine circumstances for which GIDS can do as well as or better than humans in detecting ice with a threshold consistent with safety and efficient ground operations in icing conditions.

10. Action.

a. Distribution. POIs shall distribute these tables to all part 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. Holdover Time Guidelines. POIs shall 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 shall provide the carriers with the following information, which should be incorporated into their approved ground deicing/anti-icing updates for the 2008-2009 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; and
- Incomplete removal of contamination.

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

*1.*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. 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.

*2.*Additionally, cover the entire aircraft surface by the deicing operation rather than rely on fluid flow back over contaminated areas. This will provide greater assurance that no frozen precipitation remains under the deicing fluid.

*3.*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, or in the case of Types II, III, and IV fluids, they are applied in the temperature ranges for undiluted and dilutions 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.

(c) Ground testing the effectiveness of Types 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.

(d) 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 prior to 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; and
- 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; and
- 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.

e. References. Refer to Order 8900.1, Flight Standards Information Management System (FSIMS), Volume 6, Chapter 2, Section 15, Ground Deicing/Anti-icing Inspections for Parts 121 and 135; and Volume 3, Chapter 27, Ground Deicing/Anti-icing Programs.

11. 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 "N8900.55" (no quotes or punctuation). POIs should use the comments section to record comments of interaction with the operators.

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

a. 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. 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 Surveillance Program (CSP) 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.

13. 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 **"N890055"** 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.

14. Disposition. We will permanently incorporate the information in this notice in FSIMS before this notice expires. Direct questions concerning this notice to the Air Carrier Operations Branch, AFS 220 at (202) 267-8166.

ORIGINAL SIGNED by

James J. Ballough
Director, Flight Standards Service

ICE PELLET ALLOWANCE TIMES

HEAVY SNOW PROCEDURES

PILOT ASSESSMENT of PRECIPITATION INTENSITY

WINTER 2008-2009

1. BACKGROUND. In October 2005, the Federal Aviation Administration (FAA) issued N 8000.309, Dispatching During Precipitation Conditions of Ice Pellets, Snow Pellets, or Other Icing Events for which No Hold Over Times Exist, and N 8000.313, Parts 121 and 135 Operations Specifications for Deicing/Anti-icing Operations in Ice Pellets Without Deice/ Anti-ice Fluids. August of 2006, the FAA issued N 8000.327, Guidance and Procedures During Light Ice Pellet and in Heavy Snow Conditions. As a result of this notice industry requested the FAA conduct research to obtain data to support additional operational allowances for ice pellets (light and moderate) and light ice pellets mixed with other forms of precipitation and also operational consideration for Type IV anti-icing fluid with embedded ice pellets “aged” beyond its allowance time when the precipitation stops at or prior to the expiration of the allowance time. That research was conducted during the winter season of 2006-07. The following guidance is a result of that research and further review of existing data. Although these stated precipitation condition allowances are provided, the general requirement that takeoff not be attempted with any contaminant adhering to the critical surfaces of the aircraft still applies. The guidance contained in the following paragraphs 2, 3, 4, and 5 are unchanged from the guidance contained in the winter update notice published for winter 2007-2008.

2. OPERATIONS IN LIGHT AND MODERATE ICE PELLETS AND LIGHT ICE PELLETS MIXED WITH OTHER FORMS OF PRECIPITATION PRESENT.

a. Tests have shown that ice pellets generally remain in the frozen state imbedded in Type IV anti-icing fluid, and are not absorbed 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 imbedded) would be an indication that the fluid has failed. These imbedded ice pellets are generally not detectable by the human eye during pretakeoff contamination check procedures. Therefore, a pretakeoff contamination check in ice pellet conditions would not be of value.

b. The tests and research data have 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 Type IV fluid will not prevent the fluid from flowing off the aerodynamic surfaces during takeoff. This flow due to shearing occurs with rotation speeds consistent with Type IV anti-icing fluid recommended applications for up to the applicable allowance time listed in Table-1. These allowance times are from the start of the Type IV anti-icing fluid application. Additionally, if the ice pellet condition stops, and the allowance time has not been exceeded, and the outside air temperature (OAT) has remained constant or increased from the temperature on which the allowance time was based, the operator is permitted to consider the Type IV anti-icing fluid effective without any further action up to **90 minutes after the start of the application time of the Type IV anti-icing fluid.**

Examples:

(1) Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 00C, light ice pellets fall until 10:20 and stop and do not restart. The allowance time stops at 10:50; however, provided that the OAT remains constant or increases and 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 00C, light ice pellets mixed with freezing drizzle falls until 10:10 and stops and restarts at 10:15 and stops 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) On the other hand, if Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 00C, light ice pellets mixed with freezing drizzle falls until 10:10 and stops and restarts 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 approved in accordance with Title 14 of the Code of Federal Regulations (14 CFR) part 121, § 121.629, will be allowed, in the specified ice pellet conditions and corresponding OAT listed in Chart 1, Ice Pellet Allowance Times Winter 2007-2008, up to the specific allowance time listed in this chart after the start of the anti-icing fluid application to commence the takeoff with the following restrictions:

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

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

(3) Due to the shearing qualities of Type IV fluids with embedded ice pellets, this allowance is limited to aircraft with a rotation speed of 100 knots or greater.

(4) If the takeoff is not accomplished within the applicable allowance time in Chart 1, 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 in Chart 1 and does not restart, the aircraft may takeoff up to 90 minutes after the start of the application of the Type IV anti-icing fluid provided the temperature on which the allowance time was based remains constant or increases.

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

(6) 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.

(7) If the temperature decreases below the temperature on which the allowance time was based:

(a) 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.

(b) And 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.

Note: In cases where the Weather forecasts and Aviation Routine Weather Reports (METAR) is reporting multiple types of precipitation occurring simultaneously, the intensity provided applies solely to the first precipitation type listed. The second precipitation type listed will be of equal or lesser intensity.

Chart 1. Ice Pellet Allowance Times

	OAT -5^0 C or Warmer	**OAT Colder Than -5^0 C**
Light Ice Pellets	50 Minutes	30 Minutes
Moderate Ice Pellets	25 Minutes	10 Minutes
Light Ice Pellets Mixed with Light or Moderate Snow	25 Minutes	Operations Not Authorized
Light Ice Pellets Mixed with Light or Moderate Freezing Drizzle, or Light Freezing Rain (Operations not authorized below -10^o C OAT)	25 Minutes	10 Minutes (Operations Not Authorized below -10^o C OAT)
Light Ice Pellets Mixed with Light Rain (Operations not authorized below 0^o C OAT)	25 Minutes (Operations Not Authorized below 0^o C OAT)	(Operations Not Authorized below 0^o C OAT

3. Operations in Heavy Snow.

a. No holdover times (HOT) exist for heavy snow conditions in the current HOT tables. Review of existing data from past testing has indicated with proper tactile and/or visual checks, as appropriate for the aircraft, and a determination that the fluid has not failed, takeoffs may be safely conducted. 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 (i.e., 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 principal operations inspector (POI).

b. 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:

(1) The aircraft must be anti-iced with undiluted Type IV fluid.

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

(3) The operator must accomplish an approved tactile and/or visual check, as appropriate, of the aircraft critical surfaces within 5 minutes of takeoff.

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

(5) 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 prior to 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 system and devices to adequately provide anti-icing.

4. OTHER CONDITIONS FOR WHICH NO HOLDOVER TIMES EXIST. (Heavy Ice Pellets, Snow Pellets, Moderate and Heavy Freezing Rain, and Hail).

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

b. The regulations clearly state "no person may take off an aircraft when frost, ice, or snow is adhering to the wings…" (part 121, § 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 de icing 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.

5. GUIDELINES FOR PILOT ASSESSMENT OF PRECIPITATION INTENSITY PROCEDURES.

a. 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. Before a pilot takes action on his/her own precipitation intensity assessment, he/she shall 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. The company's approved deicing program in accordance with § 121.629 must contain the required company coordination procedures for a pilot when he chooses to take actions that are based on his/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. When a pilot acts based on his/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) as per the approved procedure for the applicable aircraft is required within five 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. 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 1B 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) shall 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 drop 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 1B 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.

Table 1B: Snowfall INTENSITIES as a Function of Prevailing Visibility

<table>
<tr><th rowspan="2">Time of Day</th><th colspan="2">Temp.</th><th colspan="7">Visibility (Statute Mile)</th><th rowspan="2"></th></tr>
<tr><th>Degrees Celsius</th><th>Degrees Fahrenheit</th><th>≥ 2 1/2</th><th>2</th><th>1 1/2</th><th>1</th><th>3/4</th><th>1/2</th><th>≤ 1/4</th></tr>
<tr><td rowspan="2">Day</td><td>colder/equal -1</td><td>colder/equal 30</td><td>Very Light</td><td>Very Light</td><td>Light</td><td>Light</td><td>Moderate</td><td>Moderate</td><td>Heavy</td><td rowspan="4">Snowfall Intensity</td></tr>
<tr><td>warmer than -1</td><td>warmer than 30</td><td>Very Light</td><td>Light</td><td>Light</td><td>Moderate</td><td>Moderate</td><td>Heavy</td><td>Heavy</td></tr>
<tr><td rowspan="2">Night</td><td>colder/equal -1</td><td>colder/equal 30</td><td>Very Light</td><td>Light</td><td>Moderate</td><td>Moderate</td><td>Heavy</td><td>Heavy</td><td>Heavy</td></tr>
<tr><td>warmer than -1</td><td>warmer than 30</td><td>Very Light</td><td>Light</td><td>Moderate</td><td>Heavy</td><td>Heavy</td><td>Heavy</td><td>Heavy</td></tr>
</table>

Note: Based upon technical report, "The Estimation of Snowfall Rate Using Visibility," Rasmussen, et al., Journal of Applied Meteorology, October 1999 and additional in situ data.

Note: This table is to be used with Type I fluid guidelines. It may also be used with Type II, III, or IV fluid.

HEAVY = Caution—No Holdover Time Guidelines Exist

Note: During snow conditions alone the use of Table 1B 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.

(4) Training Requirements.

(a) Pilots that are limited in their precipitation intensity assessments to whether or not precipitation is falling shall 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.)

(b) 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 2, shall be used as the source documents for this training.)

Note: 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.

OFFICIAL FAA HOLDOVER TIME TABLES

WINTER 2008-2009

SUMMARY OF CHANGES FROM 2007-2008

1. TYPE I FLUIDS. The Type I fluid holdover time (HOT) table values are unchanged.

2. TYPE II FLUIDS. One new Type II fluid, Kilfrost ABC-K Plus, has been added to the list of qualified Type II fluids. The addition of this fluid did not cause any of the values to change in the Type II generic HOT table, Table 2. A brand specific table has been added for this new fluid (Table 2F). Aviation Xi'an High-Tech KHF-II, which was added to the list of qualified fluids in 2007 was removed due to fluid specification concerns. Specifically, there may still be batches of the fluid on the market that were shipped/delivered with viscosities lower than the published Lowest On-Wing Viscoisty for use with the HOT guidelines. More recently, Aviation Xi'an High Tech indicated to the FAA that they were going to requalify the fluid at a higher viscosity; the FAA requested the new aerodynamic testing results, however these have not been provided by Aviation Xi'an.

3. TYPE III FLUIDS. The Type III fluid HOT table values are unchanged.

4. TYPE IV FLUIDS. In the Type IV generic HOT tables, the values were increased in the Rain on Cold Soaked Wing cells due to the removal of obsolete data.

TABLE OF CONTENTS FOR HOT GUIDELINES FOR WINTER 2008-2009

TABLE **PAGE**

FAA TYPE I HOLDOVER TIME GUIDELINE

TABLE 1. FAA GUIDELINES FOR HOLDOVER TIMES SAE TYPE I FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Approximate Holdover Times Under Various Weather Conditions (hours: minutes)								
				Snow/Snow Grains						
Degrees Celsius	Degrees Fahrenheit	Active Frost	Freezing Fog	Very Light◆◆	Light ◆◆	Moderate◆◆	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	0:45	0:11-0:17	0:18-0:22	0:11-0:18	0:06-0:11	0:09-0:13	0:02-0:05	0:02-0:05	
below -3 to -6	below 27 to 21	0:45	0:08-0:13	0:14-0:17	0:08-0:14	0:05-0:08	0:05-0:09	0:02-0:05	CAUTION: No holdover time guidelines exist	
below -6 to -10	below 21 to 14	0:45	0:06-0:10	0:11-0:13	0:06-0:11	0:04-0:06	0:04-0:07	0:02-0:05		
below -10	below 14	0:45	0:05-0:09	0:07-0:08	0:04-0:07	0:02-0:04				

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
‡ Heavy snow, snow pellets, ice pellets, moderate and heavy freezing rain, hail
◆◆ **TO USE THESE TIMES, THE FLUID MUST BE HEATED TO A MINIMUM TEMPERATURE OF 60 °C (140 °F) AT THE NOZZLE AND AT LEAST 1 LITER/M^2 (≈ 2 GALS/100FT^2) MUST BE APPLIED TO DEICED SURFACES**
SAE Type I fluid/water mixture is selected so that the freezing point of the mixture is at least 10 °C (18 °F) below OAT.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- **SAE TYPE I** FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 1A. FAA GUIDELINES FOR THE APPLICATION OF SAE TYPE I FLUID MIXTURE MINIMUM CONCENTRATIONS AS A FUNCTION OF OUTSIDE AIR TEMPERATURE

Concentrations in % volume

<table>
<tr><th rowspan="2">Outside Air Temperature (OAT)</th><th rowspan="2">One-step Procedure Deicing/Anti-icing[1]</th><th colspan="2">Two-step Procedure</th></tr>
<tr><th>First step: Deicing</th><th>Second step: Anti-icing [1, 2]</th></tr>
<tr><td>-3 °C (27 °F) and above</td><td rowspan="2">Mix of fluid and water heated to 60 °C (140 °F) minimum at the nozzle, with a freezing point of at least 10 °C (18 °F) below OAT</td><td>Heated water or a mix of fluid and water heated to 60 °C (140 °F) minimum at the nozzle</td><td rowspan="2">Mix of fluid and water heated to 60 °C (140 °F) minimum at the nozzle, with a freezing point of at least 10 °C (18 °F) below OAT</td></tr>
<tr><td>Below -3 °C (27 °F)</td><td>Freezing point of heated fluid mixture shall not be more than 3 °C (5 °F) above OAT</td></tr>
<tr><td colspan="4">1) Fluids must only be used at temperatures above their lowest operational use temperature (LOUT).
2) To be applied before first-step fluid freezes, typically within 3 minutes.</td></tr>
<tr><td colspan="4">Notes:
• Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
• To use Type I holdover time guidelines in snow conditions, at least 1 liter per square meter (2 gal. Per 100 square feet) fluid must be applied to the deiced surfaces.
• This table is applicable for the use of Type I Holdover Time Guidelines. If holdover times are not required, a temperature of 60 °C (140 °F) at the nozzle is desirable.
• The lowest operational use temperature (LOUT) for a given fluid is the higher of:
a) The lowest temperature at which the fluid meets the aerodynamic acceptance test for a given aircraft type, or
b) The actual freezing point of the fluid plus a freezing point buffer of 10°C (18°F).

Caution: Wing skin temperatures may differ and, in some cases, be lower than OAT.
A stronger mix (more glycol) can be used under these conditions.</td></tr>
</table>

TABLE 1B. SNOWFALL INTENSITIES AS A FUNCTION OF PREVAILING VISIBILITY

Time of Day	Temp.		Visibility (Statute Mile)							
	Degrees Celsius	Degrees Fahrenheit	≥ 2 1/2	2	1 1/2	1	3/4	1/2	≤ 1/4	
Day	colder/equal -1	colder/equal 30	Very Light	Very Light	Light	Light	Moderate	Moderate	**Heavy**	**Snowfall Intensity**
	warmer than -1	warmer than 30	Very Light	Light	Light	Moderate	Moderate	**Heavy**	**Heavy**	
Night	colder/equal -1	colder/equal 30	Very Light	Light	Moderate	Moderate	**Heavy**	**Heavy**	**Heavy**	
	warmer than -1	warmer than 30	Very Light	Light	Moderate	**Heavy**	**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 fluid guidelines. It may also be used with Type II, III, or IV fluid guidelines.

HEAVY = Caution—No Holdover Time Guidelines Exist

FAA TYPE II HOLDOVER TIME GUIDELINE

TABLE 2. FAA GUIDELINES FOR HOLDOVER TIMES SAE TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	**Approximate Holdover Times Under Various Weather Conditions (hours: minutes)**						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	0:35-1:30	0:20-0:45	0:30-0:55	0:15-0:30	0:05-0:40	
		75/25	5:00	0:25-1:00	0:15-0:30	0:20-0:45	0:10-0:25	0:05-0:25	
		50/50	3:00†	0:15-0:30	0:05-0:15	0:05-0:15	0:05-0:10		
below -3 to -14	below 27 to 7	100/0	8:00†	0:20-1:05	0:15-0:30	***0:15-0:45	***0:10-0:20	CAUTION: No holdover time guidelines exist	
		75/25	5:00†	0:20-0:55	0:10-0:20	***0:15-0:30	***0: 05-0: 15		
below -14 to -25	below 7 to -13	100/0	8:00†	0:15-0:20	0:15-0:30				
below -25	below -13	100/0	**SAE Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **SAE Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- SAE TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2A. FAA GUIDELINES FOR HOLDOVER TIMES ABAX (SPCA) ECOWING 26 TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	1:25-2:35	0:40-1:00	0:50-1:35	0:40-0:50	0:20-1:25	
		75/25	5:00	1:05-1:55	0:25-0:45	0:45-1:05	0:25-0:35	0:10-1:00	
		50/50	3:00†	0:30-0:45	0:10-0:20	0:15-0:25	0:05-0:10	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:45-2:15	0:35-0:55	***0:30-1:10	***0:15-0:35		
		75/25	5:00†	0:35-1:15	0:25-0:40	***0:20-0:50	***0:15-0:25		
below -14 to -25	below 7 to -13	100/0	8:00†	0:25-0:45	0:15-0:30				
below -25	below -13	100/0	**ABAX ECOWING 26 Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **ABAX ECOWING 26 Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- ABAX ECOWING 26 TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2B. FAA GUIDELINES FOR HOLDOVER TIMES CLARIANT SAFEWING MP II 2025 ECO TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	1:30-2:05	0:40-1:10	0:40-1:00	0:25-0:35	0:10-1:15	
		75/25	5:00	0:55-1:45	0:25-0:45	0:25-0:45	0:20-0:25	0:05-0:50	
		50/50	3:00†	0:20-0:35	0:05-0:15	0:10-0:15	0:05-0:10	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:45-1:50	0:35-1:00	***0:35-1:05	***0:20-0:35		
		75/25	5:00†	0:40-1:20	0:25-0:45	***0:30-0:40	***0:15-0:25		
below -14 to -25	below 7 to -13	100/0	8:00†	0:25-0:45	0:15-0:30				
below -25	below -13	100/0	**CLARIANT SAFEWING MPII 2025 ECO Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **CLARIANT SAFEWING MPII 2025 ECO Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- CLARIANT SAFEWING MP II 2025 ECO TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2C. FAA GUIDELINES FOR HOLDOVER TIMES CLARIANT SAFEWING MP II FLIGHT TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	3:30-4:00	1:00-1:35	1:20-2:00	0:45-1:25	0:10-1:30	
		75/25	5:00	2:30-4:00	0:40-1:20	1:15-2:00	0:30-0:55	0:05-1:20	
		50/50	3:00†	0:55-1:45	0:10-0:25	0:20-0:30	0:10-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:55-1:45	0:40-1:05	***0:35-1:30	***0:25-0:45		
		75/25	5:00†	0:40-1:10	0:20-0:40	***0:25-1:10	***0:30-0:40		
below -14 to -25	below 7 to -13	100/0	8:00†	0:30-0:50	0:15-0:30				
below -25	below -13	100/0	**CLARIANT SAFEWING MP II FLIGHT Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **CLARIANT SAFEWING MP II FLIGHT Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- CLARIANT SAFEWING MP II FLIGHT TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2D. FAA GUIDELINES FOR HOLDOVER TIMES KILFROST ABC-2000 TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold **Soaked** Wing**	Other‡
-3 and above	27 and above	100/0	8:00	1:30-3:05	0:30-1:00	0:55-1:35	0:40-0:50	0:15-1:10	
		75/25	5:00	1:40-3:30	0:30-1:05	0:45-1:15	0:40-0:50	0:15-1:40	
		50/50	3:00†	1:00-2:10	0:15-0:30	0:15-0:25	0:05-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:35-1:25	0:25-0:45	***0:25-0:50	***0:10-0:30		
		75/25	5:00†	0:35-1:15	0:25-0:50	***0:25-0:55	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	8:00†	0:20-0:45	0:15-0:30				
below -25	below -13	100/0	**KILFROST ABC-2000 Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **KILFROST ABC-2000 Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT
- KILFROST ABC-2000 TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2E. FAA GUIDELINES FOR HOLDOVER TIMES KILFROST ABC-II PLUS TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other ‡
-3 and above	27 and above	100/0	8:00	1:10-2:25	0:25-0:55	0:35-1:10	0:30-0:40	0:05-1:00	
		75/25	5:00	1:10-2:25	0:25-0:50	0:30-1:00	0:20-0:40	0:05-0:50	
		50/50	3:00†	0:15-0:45	0:15-0:35	0:05-0:25	0:05-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:30-1:05	0:15-0:35	***0:15-0:45	***0:10-0:30		
		75/25	5:00†	0:20-0:55	0:15-0:35	***0:15-0:30	***0:10-0:20		
below -14 to -25	below 7 to -13	100/0	8:00†	0:15-0:20	0:15-0:30				
below -25	below -13	100/0	**KILFROST ABC-II PLUS Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **KILFROST ABC-II PLUS Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- KILFROST ABC-II PLUS TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2F. FAA GUIDELINES FOR HOLDOVER TIMES KILFROST ABC-K PLUS TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other ‡
-3 and above	27 and above	100/0	8:00	2:15-3:45	1:00-1:40	1:50-2:00	1:00-1:25	0:20-2:00	CAUTION: No holdover time guidelines exist
		75/25	5:00	1:40-2:30	0:35-1:10	1:25-2:00	0:50-1:10	0:15-2:00	
		50/50	3:00†	0:35-1:05	0:05-0:15	0:20-0:30	0:10-0:15		
below -3 to -14	below 27 to 7	100/0	8:00†	0:30-1:05	0:50-1:25	***0:25-1:00	***0:15-0:35		
		75/25	5:00†	0:25-1:25	0:35-1:05	***0:25-0:55	***0:05-0:30		
below -14 to -25	below 7 to -13	100/0	8:00†	0:30-0:55	0:15-0:30				
below -25	below -13	100/0	**KILFROST ABC-K PLUS Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **KILFROST ABC-K PLUS Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- KILFROST ABC-K PLUS TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2G. FAA GUIDELINES FOR HOLDOVER TIMES NEWAVE AEROCHEMICAL FCY-2 TYPE II MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	1:15-2:25	0:30-0:55	0:35-1:05	0:25-0:35	0:05-0:45	
		75/25	5:00	0:50-1:30	0:20-0:40	0:25-0:45	0:15-0:25	0:05-0:25	
		50/50	3:00†	0:25-0:35	0:15-0:25	0:10-0:20	0:05-0:10	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:45-1:30	0:15-0:30	***0:20-0:45	***0:15-0:20		
		75/25	5:00†	0:30-1:05	0:10-0:20	***0:15-0:30	***0:05-0:15		
below -14 to -25	below 7 to -13	100/0	8:00†	0:25-0:35	0:15-0:30				
below -25	below -13	100/0	**NEWAVE AEROCHEMICAL FCY-2 Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **NEWAYE AEROCHEMICAL FCY-2 Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- NEWAVE AEROCHEMICAL FCY-2 TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 2H. FAA GUIDELINES FOR HOLDOVER TIMES OCTAGON E-MAX TYPE II FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type II Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	8:00	2:05-3:45	0:40-1:20	0:45-1:35	0:30-0:40	0:15-1:30	
		75/25	5:00	1:25-2:50	0:25-0:55	0:40-1:10	0:20-0:30	0:10-1:05	
		50/50	3:00†	0:30-0:55	0:10-0:25	0:15-0:30	0:10-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	8:00†	0:50-1:45	0:35-1:10	***0:35-1:00	***0:20-0:30		
		75/25	5:00†	0:30-1:20	0:25-0:50	***0:35-1:05	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	8:00†	0:20-0:35	0:15-0:30				
below -25	below -13	100/0	**OCTAGON E-MAX Type II** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **OCTAGON E-MAX Type II** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- OCTAGON E-MAX TYPE II FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

FAA TYPE III HOLDOVER TIME GUIDELINE

TABLE 3. FAA GUIDELINES FOR HOLDOVER TIMES SAE TYPE III FLUID MIXTURE AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Approximate Holdover Times Under Various Weather Conditions (hours: minutes)									
					Snow/Snow Grains						
Degrees Celsius	**Degrees Fahrenheit**	**Type III Fluid Concentration Neat Fluid/Water** (Volume %/Volume %)	Active Frost	**Freezing Fog**	**Very Light**	**Light**	**Moderate**	**Freezing Drizzle***	**Light Freezing Rain**	**Rain on Cold Soaked Wing****	**Other‡**
-3 and above	27 and above	100/0	2:00	0:20 - 0:40	0:35 - 0:40	0:20 - 0:35	0:10 - 0:20	0:10 - 0:20	0:08 - 0:10	0:06 - 0:20	
		75/25	1:00	0:15 - 0:30	0:25 - 0:35	0:15 - 0:25	0:08 - 0:15	0:08 - 0:15	0:06 - 0:10	0:02 - 0:10	
		50/50	0:30	0:10 - 0:20	0:15 - 0:20	0:08 - 0:15	0:04 - 0:08	0:05 - 0:09	0:04 - 0:06		
below -3 to -10	below 27 to 14	100/0	2:00	0:20 - 0:40	0:30 - 0:35	0:15 - 0:30	0:09 - 0:15	0:10 - 0:20	0:08 - 0:10		
		75/25	1:00	0:15 - 0:30	0:25 - 0:30	0:10 - 0:25	0:07 - 0:10	0:09 - 0:12	0:06 - 0:09		
Below -10	below 14	100/0	2:00	0:20 - 0:40	0:30 - 0:35	0:15 - 0:30	0:08 - 0:15	CAUTION: No holdover time guidelines exist			
SAE Type III fluid may be used below -10 °C (14 °F), provided the freezing point of the fluid is at least 7 °C (13 °F) below OAT and aerodynamic acceptance criteria are met.											
Consider the use of **SAE Type I** when **Type III** fluid cannot be used.											

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

*Use light freezing rain holdover times if positive identification of freezing drizzle is not possible

**This column is for use at temperatures above 0 °C (32 °F) only

‡Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST WILL REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- SAE TYPE III FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR - AND DOES NOT PROVIDE - PROTECTION DURING FLIGHT.

FAA TYPE IV HOLDOVER TIME GUIDELINES

TABLE 4. FAA GUIDELINES FOR HOLDOVER TIMES SAE TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	1:15-2:30	0:35-1:15	0:40-1:10	0:25-0:40	0:10-1:05	CAUTION: No holdover time guidelines exist
		75/25	5:00	1:05-1:45	0:20-0:55	0:35-0:50	0:15-0:30	0:05-0:40	
		50/50	3:00†	0:15-0:35	0:05-0:15	0:10-0:20	0:05-0:10		
below -3 to -14	below 27 to 7	100/0	12:00†	0:20-1:20	0:20-0:40	***0:20-0:45	***0:10-0:25		
		75/25	5:00†	0:25-0:50	0:15-0:35	***0:15-0:30	***0:10-0:20		
below -14 to -25	below 7 to -13	100/0	12:00†	0:15-0:40	0:15-0:30				
below -25	below -13	100/0	**SAE Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **SAE Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- SAE TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4A. FAA GUIDELINES FOR HOLDOVER TIMES ABAX (SPCA) AD-480 TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:00-3:30	0:40-1:20	0:50-1:30	0:35-0:55	0:15-1:35	
		75/25	5:00	1:30-2:45	0:30-1:05	0:50-1:15	0:30-0:45	0:10-1:15	
		50/50	3:00†	0:30-0:45	0:10-0:20	0:15-0:25	0:05-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	0:20-1:20	0:30-0:55	***0:25-1:20	***0:15-0:30		
		75/25	5:00†	0:25-0:50	0:20-0:45	***0:25-1:05	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:15-0:40	0:15-0:30				
below -25	below -13	100/0	**ABAX AD-480 Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **ABAX AD-480 Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- ABAX AD-480 TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4B. FAA GUIDELINES FOR HOLDOVER TIMES CLARIANT SAFEWING MP IV 2001 TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit	Neat-Fluid/Water (Volume %/Volume %)	Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	1:20-3:20	1:00-1:55	0:55-1:55	0:40-1:00	0:15-2:00	
		75/25	5:00	1:20-2:00	0:35-1:00	0:35-1:10	0:25-0:35	0:10-1:25	
		50/50	3:00†	0:15-0:40	0:10-0:20	0:10-0:20	0:05-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	0:45-1:35	0:30-0:50	***0:55-1:35	***0:30-0:45		
		75/25	5:00†	0:30-1:00	0:20-0:35	***0:40-1:10	***0:20-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:20-0:45	0:15-0:30				
below -25	below -13	100/0	**CLARIANT SAFEWING MP IV 2001 Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **CLARIANT SAFEWING MP IV 2001 Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- CLARIANT SAFEWING MP IV 2001 TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4C. FAA GUIDELINES FOR HOLDOVER TIMES CLARIANT SAFEWING MP IV 2012 PROTECT TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	1:15-2:30	0:40-1:15	0:40-1:10	0:25-0:45	0:10-1:05	
		75/25	5:00	1:10-2:05	0:25-0:55	0:35-0:50	0:15-0:30	0:05-0:40	
		50/50	3:00†	0:25-0:45	0:15-0:25	0:15-0:20	0:05-0:10	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	0:45-1:45	0:20-0:40	***0:25-0:45	***0:15-0:25		
		75/25	5:00†	0:25-1:05	0:20-0:40	***0:15-0:30	***0:10-0:20		
below -14 to -25	below 7 to -13	100/0	12:00†	0:20-0:45	0:15-0:30				
below -25	below -13	100/0	**CLARIANT SAFEWING MP IV 2012 PROTECT TYPE IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **CLARIANT SAFEWING MP IV 2012 PROTECT TYPE IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- CLARIANT SAFEWING MP IV 2012 PROTECT TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4D. FAA GUIDELINES FOR HOLDOVER TIMES CLARIANT SAFEWING MP IV LAUNCH TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	4:00-4:00	1:05-1:45	1:30-2:00	1:00-1:40	0:15-1:40	
		75/25	5:00	3:40-4:00	1:00-1:45	1:40-2:00	0:45-1:15	0:10-1:45	
		50/50	3:00†	1:25-2:45	0:25-0:45	0:30-0:50	0:20-0:25	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	1:00-1:55	0:50-1:20	***0:35-1:40	***0:25-0:45		
		75/25	5:00†	0:40-1:20	0:45-1:25	***0:25-1:10	***0:25-0:45		
below -14 to -25	below 7 to -13	100/0	12:00†	0:30-0:50	0:15-0:30				
below -25	below -13	100/0	**CLARIANT SAFEWING MPIV LAUNCH Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **CLARIANT SAFEWING MPIV LAUNCH Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- CLARIANT SAFEWING MP IV LAUNCH TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4E. FAA GUIDELINES FOR HOLDOVER TIMES DOW UCAR™ ULTRA+ ADF/AAF TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	1:35-3:35	0:35-1:15	0:45-1:35	0:25-0:40	0:10-1:20	CAUTION: No holdover time guidelines exist
		75/25							
		50/50							
below -3 to -14	below 27 to 7	100/0	12:00†	1:25-3:00	0:25-0:55	***0:45-1:25	***0:30-0:45		
		75/25							
below -14 to -24	below 7 to -12	100/0	12:00†	0:40-2:10	0:20-0:45				
below -24	below -12	100/0	**DOW UCAR ULTRA+ Type IV** fluid may be used below -24 °C (-12 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **DOW UCAR ULTRA+ Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
†Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- DOW UCAR ULTRA+ TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4F. FAA GUIDELINES FOR HOLDOVER TIMES DOW UCAR™ ENDURANCE EG106 TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:05-3:10	0:40-1:20	1:10-2:00	0:50-1:15	0:20-2:00	
		75/25						CAUTION: No holdover time guidelines exist	
		50/50							
below -3 to -14	below 27 to 7	100/0	12:00†	1:50-3:20	0:30-1:05	***0:55-1:50	***0:45-1:10		
		75/25							
below -14 to -25	below 7 to -13	100/0	12:00†	0:30-1:05	0:15-0:30				
below -25	below -13	100/0	**DOW UCAR ENDURANCE EG 106 Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **DOW UCAR ENDURANCE EG 106 Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- DOW UCAR ENDURANCE EG 106 TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4G. FAA GUIDELINES FOR HOLDOVER TIMES DOW UCAR™ FLIGHTGUARD AD-480 TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:00-3:30	0:40-1:20	0:50-1:30	0:35-0:55	0:15-1:35	CAUTION: No holdover time guidelines exist
		75/25	5:00	1:30-2:45	0:30-1:05	0:50-1:15	0:30-0:45	0:10-1:15	
		50/50	3:00†	0:30-0:45	0:10-0:20	0:15-0:25	0:05-0:15		
below -3 to -14	below 27 to 7	100/0	12:00†	0:20-1:20	0:30-0:55	***0:25-1:20	***0:15-0:30		
		75/25	5:00†	0:25-0:50	0:20-0:45	***0:25-1:05	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:15-0:40	0:15-0:30				
below -25	below -13	100/0	**DOW UCAR FLIGHTGUARD AD-480 Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **DOW UCAR FLIGHTGUARD AD-480 Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- DOW UCAR FLIGHTGUARD AD-480 TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4H. FAA GUIDELINES FOR HOLDOVER TIMES KILFROST ABC-S TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:35-4:00	1:00-1:40	1:20-1:50	1:00-1:25	0:20-1:15	CAUTION: No holdover time guidelines exist
		75/25	5:00	1:05-1:45	0:30-0:55	0:45-1:10	0:35-0:50	0:10-0:50	
		50/50	3:00†	0:20-0:35	0:05-0:15	0:15-0:20	0:05-0:10		
below -3 to -14	below 27 to 7	100/0	12:00†	0:45-2:05	0:45-1:20	***0:20-1:00	***0:10-0:30		
		75/25	5:00†	0:25-1:00	0:25-0:50	***0:20-1:10	***0:10-0:35		
below -14 to -25	below 7 to -13	100/0	12:00†	0:20-0:40	0:15-0:30				
below -25	below -13	100/0	**KILFROST ABC-S Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **KILFROST ABC-S Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- KILFROST ABC-S TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4I. FAA GUIDELINES FOR HOLDOVER TIMES KILFROST ABC-S PLUS TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:10-4:00	1:15-2:00	1:50-2:00	1:05-2:00	0:25-2:00	
		75/25	5:00	1:25-2:40	0:45-1:15	1:00-1:20	0:30-0:50	0:10-1:20	
		50/50	3:00†	0:30-0:55	0:15-0:30	0:15-0:40	0:15-0:20	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	0:55-3:30	1:00-1:45	***0:25-1:35	***0:20-0:30		
		75/25	5:00†	0:45-1:50	0:35-1:00	***0:20-1:10	***0:15-0:25		
below -14 to -25	below 7 to -13	100/0	12:00†	0:40-1:00	0:15-0:30				
below -25	below -13	100/0	**KILFROST ABC-S PLUS Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **KILFROST ABC-S PLUS Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- KILFROST ABC-S PLUS TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4J. FAA GUIDELINES FOR HOLDOVER TIMES LYONDELL ARCTIC SHIELD™ TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/ Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	1:55-3:10	0:50-1:25	0:55-1:40	0:45-1:05	0:15-1:25	
		75/25	5:00	1:20-2:15	0:40-1:05	0:55-1:25	0:30-0:45	0:05-1:20	
		50/50	3:00†	0:35-0:45	0:20-0:35	0:20-0:30	0:10-0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	1:00-2:25	0:45-1:15	***0:25-1:30	***0:25-0:30		
		75/25	5:00†	0:50-1:45	0:35-0:55	***0:30-1:15	***0:25-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:25-0:45	0:15-0:30				
below -25	below -13	100/0	**LYONDELL ARCTIC SHIELD Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **LYONDELL ARCTIC SHIELD Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 degrees Celsius (32 degrees Fahrenheit) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- LYONDELL ARCTIC SHIELD TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4K. FAA GUIDELINES FOR HOLDOVER TIMES OCTAGON MAX-FLIGHT TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:40-4:00	0:50-1:35	0:55-2:00	0:35-1:00	0:15-1:15	
		75/25	5:00	2:05-3:15	0:45-1:45	1:15-2:00	0:35-1:10	0:10-0:40	
		50/50	3:00†	0:55-1:45	0:25-1:15	0:35-1:00	0:15-0:30	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	0:50-2:30	0:25-0:50	***0:25-1:10	***0:20-0:40		
		75/25	5:00†	0:30-1:05	0:20-0:50	***0:20-1:00	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:20-0:45	0:15-0:30				
below -25	below -13	100/0	**OCTAGON MAX-FLIGHT Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **OCTAGON MAX-FLIGHT Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- OCTAGON MAX-FLIGHT TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4L. FAA GUIDELINES FOR HOLDOVER TIMES OCTAGON MAX-FLIGHT 04 TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Active Frost	Freezing Fog	Snow/Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:40-4:00	1:25-2:00	2:00-2:00	1:10-1:30	0:20-2:00	CAUTION: No holdover time guidelines exist
		75/25	5:00	2:05-3:15	1:05-2:00	1:50-2:00	1:00-1:20	0:20-2:00	
		50/50	3:00†	0:55-1:45	0:25-1:15	0:35-1:10	0:25-0:35		
below -3 to -14	below 27 to 7	100/0	12:00†	0:50-2:30	0:35-1:10	***0:25-1:30	***0:20-0:40		
		75/25	5:00†	0:30-1:05	0:40-1:20	***0:20-1:00	***0:15-0:30		
below -14 to -25	below 7 to -13	100/0	12:00†	0:20-0:45	0:15-0:30				
below -25	below -13	100/0	**OCTAGON MAX-FLIGHT 04 Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **OCTAGON MAX-FLIGHT 04 Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- OCTAGON MAX-FLIGHT 04 TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

TABLE 4M. FAA GUIDELINES FOR HOLDOVER TIMES OCTAGON MAXFLO TYPE IV FLUID MIXTURES AS A FUNCTION OF WEATHER CONDITIONS AND OUTSIDE AIR TEMPERATURE

CAUTION: THIS TABLE IS FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Outside Air Temperature		Manufacturer Specific Type IV Fluid Concentration Neat-Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours: minutes)						
Degrees Celsius	Degrees Fahrenheit		Frost	Freezing Fog	Snow /Snow Grains	Freezing Drizzle*	Light Freezing Rain	Rain on Cold Soaked Wing**	Other‡
-3 and above	27 and above	100/0	12:00	2:20-3:35	0:40-1:30	1:20-2:00	0:30-1:00	0:10-2:00	
		75/25	5:00	1:25-2:00	0:20-0:55	0:40-1:05	0:20-0:35	0:05-1:15	
		50/50	3:00†	0:20-0:40	0:05-0:15	0:10-0:20	0:05-0:10	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	12:00†	1:10-2:20	0:25-1:00	***0:35-1:45	***0:30-0:50		
		75/25	5:00†	0:40-1:25	0:15-0:40	***0:35-1:15	***0:15-0:30		
Below -14 to -25	below 7 to -13	100/0	12:00†	0:30-1:00	0:15-0:30				
below -25	below -13	100/0	**OCTAGON MAXFLO Type IV** fluid may be used below -25 °C (-13 °F) provided the freezing point of the fluid is at least 7 °C (13 °F) below the OAT and the aerodynamic acceptance criteria are met. Consider use of **SAE Type I** when **OCTAGON MAXFLO Type IV** fluid cannot be used.						

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

* Use light freezing rain holdover times if positive identification of freezing drizzle is not possible
** This column is for use at temperatures above 0 °C (32 °F) only
*** No holdover time guidelines exist for this condition below -10 °C (14 °F)
‡ Snow pellets, ice pellets, heavy snow, moderate and heavy freezing rain, and hail
† Radiational cooling during active frost conditions may reduce holdover times when operating close to the lower end of the outside air temperature range.

CAUTIONS:

- THE TIME OF PROTECTION WILL BE SHORTENED IN HEAVY WEATHER CONDITIONS. HEAVY PRECIPITATION RATES OR HIGH MOISTURE CONTENT, HIGH WIND VELOCITY, OR JET BLAST MAY REDUCE HOLDOVER TIME BELOW THE LOWEST TIME STATED IN THE RANGE. HOLDOVER TIME MAY BE REDUCED WHEN AIRCRAFT SKIN TEMPERATURE IS LOWER THAN OAT.
- OCTAGON MAXFLO TYPE IV FLUID USED DURING GROUND DEICING/ANTI-ICING IS NOT INTENDED FOR AND DOES NOT PROVIDE PROTECTION DURING FLIGHT.

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

Concentrations in % Volume

<table>
<tr><th rowspan="2">Outside Air Temperature (OAT)</th><th rowspan="2">One-step Procedure
Deicing/Anti-icing[1]</th><th colspan="2">Two-step Procedure</th></tr>
<tr><th>First step: Deicing</th><th>Second step: Anti-icing[1, 2,]</th></tr>
<tr><td>-3 °C (27 °F)
and above</td><td>50/50
Heated[3] Types II, III or IV</td><td>Heated water or a
heated mix of Types I, II, III
or IV and water</td><td>50/50 Type II, III, or IV</td></tr>
<tr><td>Below -3 °C (27 °F)
to -14 °C (7 °F)</td><td>75/25
Heated[3] Types II, III or IV</td><td>Heated suitable mix of
Types I, II, III or IV, and water
with a freezing point not more than
3 °C (5 °F) above actual OAT</td><td>75/25 Type II, III, or IV</td></tr>
<tr><td>below -14 °C (7 °F)
to -25 °C (-13 °F)</td><td>100/0
Heated[3] Types II, III or IV</td><td>Heated suitable mix of
Types I, II, III or IV, and water
with a freezing point not more than
3 °C (5 °F) above actual OAT</td><td>100/0 Type II, III, or IV</td></tr>
<tr><td>Below -25 °C (-13 °F)</td><td colspan="3">SAE Type II/IV fluid may be used below -25 °C (-13 °F) provided that the OAT is at or above the LOUT.
SAE Type III fluid may be used below -10°C (14°F) provided that the OAT is at or above the LOUT
Consider the use of SAE Type I when Type II, III, or IV fluid cannot be used.</td></tr>
<tr><td colspan="4">1) Fluids must only be used at temperatures above their lowest operational use temperature (LOUT).
2) To be applied before first step fluid freezes, typically within 3 minutes.
3) Clean aircraft may be anti-iced with unheated Types II, III, or IV fluid.</td></tr>
<tr><td colspan="4">NOTES:
• For heated fluids, a fluid temperature not less than 60 °C (140 °F) at the nozzle is desirable. Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
• The lowest operational use temperature (LOUT) for a given fluid is the higher of:
a) The lowest temperature at which the fluid meets the aerodynamic acceptance test for a given aircraft type, or
b) The actual freezing point of the fluid plus a freezing point buffer of 7°C (13°F).</td></tr>
<tr><td colspan="4">CAUTIONS:
• Wing skin temperatures may differ and in some cases may be lower than OAT. A stronger mix (more glycol) can be used under these conditions.
• As fluid freezing may occur, 50/50 Types II, III, or IV fluid shall not be used for the anti-icing step of a cold-soaked wing as indicated by frost or ice on the lower surface of the wing in the area of the fuel tank.
• An insufficient amount of anti-icing fluid, especially in the second step of a two-step procedure, may cause a substantial loss of holdover time, particularly when using a Type I fluid mixture for the first step (deicing) of a two-step procedure.</td></tr>
</table>

TABLE 6

LOWEST ON-WING VISCOSITY VALUES FOR ANTI-ICING FLUIDS

(See Page 35 for Table 6 Notes)

Table 6-1: Type II Anti-Icing Fluids

FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY [a] (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 REVISION A METHOD
ABAX (SPCA) Ecowing 26	100/0	4,900 [e]	4,600 [g]
	75/25	2,200 [g]	2,200 [g]
	50/50	50 [g]	50 [g]
Clariant Safewing MP II 2025 ECO	100/0	5,500 [b]	5,750 [g]
	75/25	10,000 [b]	10,000 [g]
	50/50	3,000 [b]	3,250 [g]
Clariant Safewing MP II Flight	100/0	3,340 [g]	3,340 [g]
	75/25	17,500 [g]	17,500 [g]
	50/50	11,500 [g]	11,500 [g]
Clariant Safewing MP II 1951	100/0	2,500 [b]	2,750 [g]
	75/25	2,900 [b]	3,000 [g]
	50/50	50 [b]	50 [g]
Kilfrost ABC-3	100/0	2,500 [c]	2,500 [j]
	75/25	2,000 [c]	2,000 [j]
	50/50	400 [c]	400 [j]
Kilfrost ABC-2000	100/0	2,350 [c]	2,350 [g]
	75/25	3,000 [c]	3,000 [j]
	50/50	1,000 [c]	1,000 [j]
Kilfrost ABC-II Plus	100/0	3,600 [c]	3,600 [g]
	75/25	4,000 [c]	4,000 [j]
	50/50	1,000 [c]	1,000 [j]
Kilfrost ABC-K Plus	100/0	2,850 [c]	2,640 [g]
	75/25	12,650 [c]	12,650 [c]
	50/50	4,200 [c]	5,260 [g]
Newave Aerochemical FCY-2	100/0	7,000 [c]	8,920 [g]
	75/25	18,550 [c]	18,550 [c]
	50/50	6,750 [c]	7,030 [g]
Octagon E Max II	100/0	13,520 [d]	13,520 [g]
	75/25	11,400 [g]	11,400 [g]
	50/50	2,820 [g]	2,820 [g]

Table 6-2: Type III Anti-Icing Fluids			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY [a] (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 REVISION A METHOD
Clariant Safewing MP III 2031 ECO	100/0	30 [h]	Not Applicable
	75/25	55 [h]	Not Applicable
	50/50	10 [h]	Not Applicable

Table 6.3 Type IV Anti-Icing Fluids			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY [a] (mPa.s)	
		MANUFACTURER METHOD	SAE AIR 9968 REVISION A METHOD
ABAX (SPCA) AD-480	100/0	15,200 [e]	12,800 [c]
	75/25	16,000 [e]	12,400 [c]
	50/50	4,000 [e]	3,800 [g]
Clariant Safewing MP IV 2001	100/0	18,000 [b]	18,000 [c]
	75/25	8,000 [b]	11,500 [g]
	50/50	1,200 [b]	1,750 [g]
Clariant Safewing MP IV 2012 Protect	100/0	7,800 [b]	7,250 [g]
	75/25	17,800 [b]	17,700 [c]
	50/50	4,500 [b]	4,250 [g]
Clariant Safewing MP IV Launch	100/0	7,550 [g]	7,550 [g]
	75/25	18,000 [g]	18,000 [g]
	50/50	17,800 [g]	17,800 [g]
Dow UCAR ADF/AAF ULTRA+	100/0	36,000 [f]	28,000 [c]
	75/25	Dilution Not Applicable	Dilution Not Applicable
	50/50	Dilution Not Applicable	Dilution Not Applicable
Dow UCAR Endurance EG106	100/0	24,850 [f]	2,230 [g]
	75/25	Dilution Not Applicable	Dilution Not Applicable
	50/50	Dilution Not Applicable	Dilution Not Applicable
Dow UCAR FlightGuard AD-480	100/0	15,200 [e]	12,800 [c]
	75/25	16,000 [e]	12,400 [c]
	50/50	4,000 [e]	3,800 [g]
Kilfrost ABC-S	100/0	17,000 [c]	17,000 [c]
	75/25	12,000 [c]	12,000 [c]
	50/50	2,000 [c]	2,000 [j]
Kilfrost ABC-S PLUS	100/0	17,900 [c]	17,900 [c]
	75/25	18,300 [c]	18,300 [c]
	50/50	7,500 [c]	7,500 [j]
Lyondell Arctic Shield	100/0	23,150 [i]	28,000 [c]
	75/25	21,700 [i]	22,100 [c]
	50/50	6,400 [i]	7,640 [g]

Octagon Max-Flight	100/0	5,540 [d]	5,540 [g]
	75/25	15,000 [g]	15,000 [g]
	50/50	5,200 [g]	5,200 [g]
Octagon Max-Flight 04	100/0	5,540 [d]	5,540 [g]
	75/25	15,000 [g]	15,000 [g]
	50/50	5,200 [g]	5,200 [g]
Octagon MaxFlo	100/0	8,670 [g]	8,670 [g]
	75/25	8,200 [g]	8,200 [g]
	50/50	2,200 [g]	2,200 [g]

NOTES

a. The SAE Aerospace Information Report (AIR) 9968 Revision A (December 2004) viscosity method should only be used for field verification and auditing purposes; when in doubt as to which method is appropriate, use the manufacturer method.

b. Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of fluid, at 20°C, 0.3 rpm, for 15 minutes 0 seconds.

c. Brookfield Spindle LV2-disc with guard leg, 150 mL of fluid, at 20°C, 0.3 rpm, for 10 minutes 0 seconds.

d. Brookfield Spindle LV1 with guard leg, 500 mL of fluid, at 20°C, 0.3 rpm, for 33 minutes 20 seconds.

e. Brookfield Spindle SC4-34/13R, small sample adapter, 10 mL of fluid, at 20°C, 0.3 rpm, for 30 minutes 0 seconds.

f. Brookfield Spindle SC4-31/13R, small sample adapter, 10 mL of fluid, at 0°C, 0.3 rpm, for 10 minutes 0 seconds.

g. Brookfield Spindle LV1 with guard leg, 500 mL of fluid, at 20ºC, 0.3 rpm, for 10 minutes 0 seconds.

h. Brookfield Spindle LV0, UL-Adapter, 16 mL of fluid, at 20ºC, 0.3 rpm, for 10 minutes 0 seconds.

i. Brookfield Spindle SC4-31/13R, small sample adapter, 9 mL of fluid, at 20°C, 0.3 rpm, for 33 minutes 0 seconds.

j. Brookfield Spindle LV1 with guard leg, 150 mL of fluid, at 20ºC, 0.3 rpm, for 10 minutes 0 seconds.

SIGNIFICANCE OF TABLE 6. The viscosity values of the fluids in Table 6 are those provided by the fluid manufacturers for holdover time testing. For the holdover time guidelines to be valid, the viscosity of the fluid on the wing shall not be lower than that listed in this table. The user should periodically ensure that the viscosity of a fluid sample taken from the wing is not lower than the value listed here.

TABLE 7. LIST OF QUALIFIED [1] DEICING/ANTI-ICING FLUIDS-WINTER 2008-2009

Qualified Type I Deicing/Anti-Icing Fluids

Company Name	Fluid Name
ABAX Industries (formerly SPCA)	ABAX DE-950
ABAX Industries (formerly SPCA)	ABAX DE-950 Colorless
Arkton Ltd.	Artica DG
Aviation Xi'an High-Tech	KHF-1
Battelle	D^3: Degradable by Design Deicer™ ADF 1006A
Beijing Wangye Aviation Chem. Prod. Co.	KLA-1
Beijing Wangye Aviation Chem. Prod. Co	YJF-1
Chemical Specialists and Development	Prist Wing Deicer
Clariant GmbH	Safewing MPI 1938 TF
Clariant GmbH	Safewing MPI 1938 TF Pre-mix
Clariant GmbH	Safewing MP I 1938 ECO (80)
Clariant GmbH	Safewing MP I 1938 ECO (80) Pre-mix
Clariant GmbH	Safewing MP I 1938 ECO
Clariant GmbH	Safewing EG I 1996
Dow Chemical Company	UCAR™ ADF Concentrate
Dow Chemical Company	UCAR™ ADF XL-54
Dow Chemical Company	UCAR™ PG ADF Concentrate
Dow Chemical Company	UCAR™ PG ADF Dilute 55/45
HOC Industries	SafeTemp I ES
HOC Industries	SafeTemp I ES Plus
Inland Technologies	Duragly - P ready to use
Inland Technologies	Duragly - E ready to use
Kilfrost	Kilfrost DF PLUS
Kilfrost	Kilfrost DF PLUS (80)
Kilfrost	Kilfrost DF PLUS (88)®
Kilfrost	Kilfrost DF$^{\text{SUSTAIN ™}}$
Lyondell Chemical Company	ARCOPlus®
Lyondell Chemical Company	ARCTIC Plus®
Newave Aerochemical Company	FCY-1A
Octagon Process	EcoFlo
Octagon Process	Octaflo EF
Octagon Process	Octaflo EG
Viterbo S.A.	Jarkleer SAE Type I

TABLE 7. LIST OF QUALIFIED [1] DEICING/ANTI-ICING FLUIDS-WINTER 2008-2009 (Continued)

Qualified Type II Deicing/Anti-Icing Fluids

Company Name	Fluid Name
ABAX Industries (formerly SPCA)	ABAX Ecowing 26
Clariant GmbH	Safewing MP II 1951
Clariant GmbH	Safewing MP II 2025 ECO
Clariant GmbH	Safewing MP II Flight
Kilfrost	Kilfrost ABC-II PLUS
Kilfrost	Kilfrost ABC-3
Kilfrost	Kilfrost ABC-2000
Kilfrost	Kilfrost ABC-K PLUS
Newave Aerochemical Technology	FCY-2
Octagon Process	E-Max

Qualified Type III Deicing/Anti-Icing Fluids

Company Name	Fluid Name
Clariant GmbH	Safewing MP III 2031 ECO

Qualified Type IV Deicing/Anti-Icing Fluids

Company Name	Fluid Name
ABAX (formerly SPCA)	ABAX AD-480
Clariant GmbH	Safewing MP IV 2001
Clariant GmbH	Safewing MP IV 2012 Protect
Clariant GmbH	Safewing MP IV Launch
Dow Chemical Company	UCAR™ ADF/AAF ULTRA+
Dow Chemical Company	UCAR™ Endurance EG106
Dow Chemical Company	UCAR™ FlightGuard AD-480
Kilfrost	Kilfrost ABC-S
Kilfrost	Kilfrost ABC-S Plus
Lyondell Chemical Company	ARCTIC Shield™
Octagon Process	Max-Flight
Octagon Process	Max-Flight 04

[1] Qualified indicates that the fluid has been qualified solely to the requirements of the applicable SAE anti-icing and aerodynamic performance specifications in effect at the time of certification, as conducted by the Anti-Icing Materials International Laboratory at the University of Quebec at Chicoutimi, Canada, Web site: http://www.uqac.ca/amil/index.htm. For other specification requirements for Type I fluids, see SAE AMS 1424 (latest version) and for SAE Types II, III, and IV fluids, see SAE AMS 1428 (latest version). Fluids that qualify after the issuance of this list will appear in a later update.