

Transport Canada Holdover Time (HOT) Guidelines Winter 2014-2015

Original Issue, August 2014
Revision 1.0, August 2014

This document should be used in conjunction with *Guidelines for Aircraft Ground-Icing Operations* (TP 14052E, second edition, April 2005).

The two documents complement each other and should be used together for a thorough understanding of the subject matter.

Questions or comments on the content of the holdover time guidelines should be addressed to
Transport Canada Civil Aviation Communication Centre Telephone 1-800-305-2059
Facsimile 613-949-4204 TTY (613) 990-4500 services@tc.gc.ca

To receive notification of HOT Guideline updates, subscribe to or update your e-news subscription at the following Transport Canada Web site: <http://wwwapps.tc.gc.ca/Comm/5/ListServ/menu.aspx>
Subscribing to e-news will require an email address and selecting Holdover Time (HOT) Guidelines under Publications / Air Transportation / Aviation Safety - Safety Information.

CHANGE CONTROL RECORDS

This page indicates any changes made to individual pages within the document. Changed pages have the appropriate revision date in the footer. Sidebars are shown to assist in identifying where significant changes have been made on these pages.

It is the responsibility of the end user to periodically check the following website for updates on Holdover Time Guidelines:

<http://www.tc.gc.ca/eng/civilaviation/standards/commerce-holdovertime-menu-1877.htm>

<i>REVISION</i>	<i>DATE</i>	<i>DESCRIPTION OF CHANGES</i>	<i>AFFECTED PAGES</i>	<i>AUTHOR</i>
1.0	August 2014	Correction of lowest operational use temperature for Shaanxi Cleanway Cleansurface I	54	TC / APS

SUMMARY OF CHANGES FROM PREVIOUS YEAR

The principal changes from the previous year are briefly indicated herein.

Active Frost

- The active frost holdover time (HOT) guidelines are unchanged.

Type I Fluid

- The Type I HOT guidelines are unchanged.

Type II Fluid

- A fluid-specific HOT guideline has been created for the new Type II fluid LNT Solutions P250.
- Kilfrost ABC-2000 has been removed from the Type II guidelines as per the protocol for removing obsolete fluids.
- The Type II generic HOT guidelines are unchanged.

Type III Fluid

- The Type III generic HOT guideline values are unchanged. However, a note has been added to the guideline to indicate it can only be used when fluid is applied unheated. Recent research indicates holdover times of Type III fluid can be shorter in some conditions when fluid is applied heated.

Type IV Fluid

- Fluid-specific HOT guidelines have been created for three new Type IV fluids: Clariant Max Flight Sneg, LNT Solutions E450, and Newave Aerochemical FCY 9311. Note that no holdover times are provided for 75/25 or 50/50 dilutions of E450 and FCY 9311.
- Lyondell Arctic Shield has been removed from the Type IV guidelines as per the protocol for removing obsolete fluids.
- Six decreases have been made to the Type IV generic HOT guidelines as a result of the addition of the new Type IV fluids.

Use of Visibility in Snow vs. Snowfall Intensity Table (Table 8)

- Table 8 must be used to determine snowfall intensity for the purpose of using the holdover time guidelines. A note has been added to all HOT guidelines to further clarify that Table 8 is the only acceptable means by which to assess snowfall intensity when using the HOT guidelines.

Guidance on Hail and Small Hail

- The meteorological conditions “hail” and “small hail” are not equivalent. No holdover times exist for either of these conditions; however, it has been determined that small hail is meteorologically equivalent to moderate ice pellets and therefore moderate ice pellet allowance times can be used in small hail conditions. The following changes have been made to provide clearer guidance on the use of holdover times and allowance times in hail and small hail conditions:
 - Small hail has been added to the list of “other” weather conditions for which holdover times do not exist. This list is provided as a note in each of the Type I, II, III and IV HOT guidelines.
 - Additional text has been added to the “other” weather conditions note in the Type III and Type IV HOT guidelines to guide users to the allowance time tables in ice pellet and small hail conditions.
 - Small hail has been added to the allowance time tables (Table 11 and Table 12).
 - A section on hail and small hail has been added to TP 14052E.

Ice Pellet and Small Hail Allowance Times

- Transport Canada has conducted research to provide additional guidance for aircraft operations during ice pellet conditions when operating with undiluted (100/0) Type III fluid applied unheated. A separate ice pellet allowance time table has been developed for Type III fluids and is included in this document (Table 11).
- Small hail has been added to the allowance time tables as it has been determined to be meteorologically equivalent to moderate ice pellets (see previous section). It has also been added to the titles of the allowance time guidance section and allowance time tables (Table 11 and Table 12).
- Research has indicated that Type IV propylene glycol (PG) fluids are removed less effectively during take-off when contaminated with moderate ice pellets at temperatures below -16°C. Therefore operations in these conditions are not recommended and no allowance times exist for PG fluids in conditions of moderate ice pellets at temperatures below -16°C, irrespective of aircraft rotation speed.
- Research has provided data to support a new Type IV allowance time of 7 minutes for light ice pellets mixed with moderate snow at temperatures below -5 to -10°C.

Interpretation of METAR Code GS

- The World Meteorological Organization (WMO) states METAR code GS is used for two meteorological conditions: “snow pellets” and “small hail.” However, investigation has determined that not all countries follow these guidelines. The use of the reported GS code can potentially lead to difficulties in determining which condition (snow pellets or small hail) is occurring and therefore in establishing the appropriate holdover time/allowance time. Consequently, a new section has been added to TP 14052E to provide guidance for determining which holdover times/allowance times should be used with METAR code GS.
- The SAE G-12 Holdover Time Committee passed a resolution requesting the WMO to consider establishing an international method to have separate METAR codes for small hail and snow pellets, similar to the reporting methods currently in use in the United States.

Note on Operations with Deployed Flaps/Slats

- Transport Canada is conducting research to provide additional guidance for aircraft operations with deployed flaps/slats. Transport Canada has determined that further research is necessary, therefore no changes to the operational and HOT guidelines with respect to deployed flaps/slats have been made for winter 2014-15. Further guidance is available in the *Changes to TP14052E* (Section 12.3) provided in this document.

CHANGES TO *Guidelines for Aircraft Ground-Icing Operations* (TP 14052E, second ed., April 2005)

The following changes will be incorporated into TP 14052E at its next revision. They are recorded here in advance due to the longer life cycle time associated with the updating and publication of TP 14052E and are for immediate use.

Replace Sub-Paragraph 8.1.2 (2nd paragraph), “Fluid Description”, with the following:

Anti-icing fluids are similar in composition except that they also contain polymeric thickeners. They are formulated to prevent formation of unabsorbed frozen contamination for a longer period of time than deicing fluids; however, the protection is still for a limited period of time. Although Type I fluids may be used for anti-icing, Type II, III and IV fluids are typically used in the anti-icing role because they can last for a significantly longer period of time than the Type I fluids.

Replace entire contents of Sub-Paragraph 8.1.4, “Certification Applicable to Qualified Fluids”, with the following:

8.1.4 Acceptable Fluids

Transport Canada does not approve or qualify de/anti-icing fluids.

The aircraft manufacturer will generally indicate in the Aircraft Maintenance Manual the applicable industry specification for aircraft consumable materials. The industry fluid specifications for de/anti-icing fluids was discussed in Section 8.1.3.

The SAE specifications require numerous chemical and physical tests at a specialized laboratory. These tests are principally for measuring the compatibility of materials used in aircraft construction and the physical properties of the fluid against the appropriate SAE specification.

Also, the SAE specifications require a series of anti-icing and aerodynamic performance tests. The aerodynamic performance tests are conducted in a calibrated wind tunnel, in a specialized laboratory, for the purpose of measuring the aerodynamic and “flow off” characteristics of the fluid against the appropriate SAE specification.

Further, fluids undergo HOT evaluation to assess their HOT characteristics and establish the values for the HOT guidelines for that particular fluid.

Replace Sub-Paragraph 10.4 (6th paragraph), “Procedure Selection”, with the following:

The temperature of cold soaked wings can be considerably below the ambient temperature; therefore frost can build up in localized areas. When active frost is anticipated, the holdover times will be shortened when the wings are cold soaked, particularly when using Type I fluids. Consider applying SAE Type II or IV fluid to the surfaces as these will provide greater holdover times than Type I, along with better safety margins to prevent frost accumulation. Both wings should receive a symmetrical treatment for aerodynamic reasons.

Replace Sub-Paragraph 10.4.2 (2nd paragraph), “Two Step De/Anti-Icing”, with the following:

If a two-step procedure is used, the first step is typically performed using a deicing fluid; however, alternate deicing technology or mechanical methods may be used depending on the circumstances. The selection of fluid type and concentration depends on the ambient temperature, the weather conditions and the desired holdover time. When performing a two-step process, the freezing point of a fluid used for the first step must not be more than 3°C above ambient temperature. The freezing point of an SAE Type I fluid used for a one-step process, or as the second step of a two-step operation, must be at least 10°C below the ambient temperature. The second step is to be performed before the first step freezes, typically within 3 minutes. This time may be higher than 3 minutes in some conditions, but potentially lower in heavy precipitation, colder temperatures, or for critical surfaces constructed of composite materials. If necessary, the second step shall be applied area by area. When deicing fluid is used in step 1, the application of the second step fluid will flush away the first step fluid and leave a film of anti-icing fluid, which is designed to be of adequate thickness. If freezing of the deicing fluid has occurred, step 1 must be repeated. Refer to the SAE ARP 4737 document for additional details.

Add Sub-Paragraph 10.8.1, “De/Anti-icing Fluid Compatibility with Runway Deicer”, as follows:

Recent research showed that when thickened aircraft anti-icing fluid came in contact with minimal amounts of runway deicing fluids (formate or acetate based), anti-icing protection provided by the aircraft anti-icing fluid could be diminished. The separation of the thickening agents in this fluid consequently reduce holdover time.

This can occur when fluids from the runway are splashed onto the wing by the nose gear wheels or from the use of engine thrust reversers at landing prior to when the aircraft is anti-iced using a one-step process as protection for the next flight. Additional tests also showed that when using a two-step de/anti-icing process, the application of the first step cleans off the contamination from the runway deicing fluid so that the anti-ice protection provided with the second step is not affected by the runway deicing fluids. Therefore, it is recommended that de/anti-icing applications be performed using a two-step process.

Replace Sub-Paragraph 10.11, “Applying Anti-Icing Fluid in a Hangar”, with the following:

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

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

Replace Sub-Paragraph 10.12.1 (5th paragraph), “Brooms”, with the following:

Using the wing broom to remove contamination does not always mean that the wing surface is clean and safe for flight. Every time a broom is used to remove contamination, a tactile inspection must be performed.

Replace Sub-Paragraph 10.13.3, “Hot Water”, with the following:

Hot water may be used to remove large amounts of contamination (such as ice) from an aircraft, provided that the Outside Air Temperature is -3°C and above as per the application procedures for SAE Type I, II, III and IV fluids described in tables 6 and 7 of the Transport Canada HOT Guidelines document.

Delete Sub-Paragraph 10.13.3.1 Item g) only.**Replace entire contents of 10.13.5 to 10.13.5.4 with the following:****10.13.5 Ground Ice Detection Systems (GIDS)**

The development of ground ice detection sensors has been stimulated by the difficulty in determining whether an aircraft is free of frozen contaminants prior to takeoff. Humans have a limited ability to accurately evaluate the condition of an aircraft's critical surface during ground icing operations. Impediments to ensuring the aircraft is free of frozen contaminants include poor lighting conditions, visibility restrictions due to blowing snow, and the difficulty in determining whether clear ice is present.

For the purposes of this document, these sensors are referred to as Remote on Ground Ice Detection Systems (ROGIDS). A Minimum Operational Performance Specification (MOPS) for these systems is identified in the SAE document AS 5681.

Air operators or service providers seeking authorization to incorporate ROGIDS into their operations should consult Transport Canada Advisory Circular AC 602-001, “Operational Use of Remote on Ground Ice Detection Systems (ROGIDS) for Post De-icing Applications”. This document is available at the following website:

<http://www.tc.gc.ca/media/documents/ca-opssvs/602-001.pdf>

Replace Sub-Paragraph 11.1.2, “Current Holdover Time Guidelines”, with the following:

Current HOT Guidelines can be found at the following website:
<http://www.tc.gc.ca/eng/civilaviation/standards/commerce-holdovertime-menu-1877.htm>

The following information can be found at the above website:

- a) Active Frost HOT Guidelines;
- b) Type I Fluid Generic HOT Guidelines;
- c) Type II Fluid HOT Guidelines;
- d) Type III Fluid HOT Guidelines;
- e) Type IV Fluid HOT Guidelines;
- f) List of Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance;
- g) SAE Type I De/Anti-Icing Fluid Application Procedures;
- h) SAE Types II, Type III and Type IV De/Anti-Icing Fluid Application Procedures;
- i) Visibility in Snow vs. Snowfall Intensity Chart;
- j) Lowest On-Wing Viscosity Values for De/Anti-Icing Fluids;
- k) Lowest Operational Use Temperatures of De/Anti-Icing Fluids; and
- l) Ice Pellet and Small Hail Allowance Times.

Replace Sub-Paragraph 11.1.4.1 a) “Estimating the Precipitation Rate” with the following:

The METAR/SPECI reported snowfall intensity is based only on observed visibility in accordance with the Environment Canada MANOBS. Scientific research has demonstrated that the use of observed visibility in snow as the sole criteria in the MANOBS, for establishing snow intensity is not accurate enough for use with the holdover time guidelines. The evidence indicates that a visibility and temperature pair needs to be used for establishing the more accurate snowfall intensity required for use with the holdover time guidelines.

The highest snowfall intensities occur near 0°C. It has also been determined that during night time snowfall conditions, for the same snowfall intensity, visibility is about twice as good as it is during the day (i.e. one can see further at night than during the day for the same snowfall intensity). This factor must be considered in estimating the snowfall intensity.

The relationship between visibility and snowfall intensity was analyzed and is documented in TP14151E. The relevant information from TP14151E is contained in the Transport Canada “visibility in snow vs. snowfall intensity chart” contained in the holdover time guidelines.

The METAR/SPECI reported visibility or flight crew observed visibility will be used with the “visibility in snow vs. snowfall intensity chart” to establish snowfall intensity for Type I, II, III and IV holdover time guidelines, during snow, snow grain, or snow pellet precipitation conditions.

The “visibility in snow vs. snowfall intensity chart”, should also be used when snow, snow grains or snow pellets are accompanied by blowing or drifting snow in the METAR/SPECI.

Examples:

CYUY 161300Z 26005KT 1SM -SN OVC015 M01/M05 A2964

In the above METAR the snowfall intensity is reported as light. However, based upon the Transport Canada “visibility in snow vs. snowfall intensity chart”, with a visibility of 1 statute mile, in daylight and a temperature of -1°C, the snowfall intensity is classified as moderate. The snowfall intensity of moderate – not the METAR reported intensity of light – will be used to determine which HOT Guideline value is appropriate for the fluid in use.

CYVO 160200Z 15011G17KT 1SM -SN DRSN OVC009 M06/M08 A2948

In the above METAR the snowfall intensity is reported as light. However, based upon the Transport Canada “visibility in snow vs. snowfall intensity chart”, with a visibility of 1 statute mile, in darkness and a temperature of -6°C, the snowfall intensity is classified as moderate. The snowfall intensity of moderate – not the METAR reported intensity of light – will be used to determine which HOT Guideline value is appropriate for the fluid in use.

Rarely, there may be circumstances where the METAR/SPECI reported visibility or flight crew observed visibility is substantially reduced due to obscuration conditions such as fog, mist, freezing fog, dust, haze, or smoke. These obscuration conditions contribute very little to the overall catch rate at the wing surface and using the “visibility in snow vs. snowfall intensity chart”, would likely over estimate the snow fall intensity.

Under these conditions and with a careful assessment by the flight crew to ensure that the obscuration conditions are not concealing significant snowfall intensities, the METAR/SPECI reported snowfall intensity can be used.

Example:

CYTS 231000Z 21003KT ½ SM SN FZFG OVC003 M03/M03 A2969

In the above METAR, the snowfall intensity is reported as moderate. Based on the Transport Canada “visibility in snow vs. snowfall intensity chart”, with a visibility of ½ statute mile, in darkness and a temperature of -3°C, the snowfall intensity is classified as heavy. However, since freezing fog is present as an obscuring condition, a moderate snowfall intensity (as reported in the METAR) can be used to determine which HOT Guideline value is appropriate for the fluid in use, provided the crew can ensure that the obscuration is not concealing significant snowfall intensities.

NOTE: The Transport Canada ‘visibility in snow vs. snowfall intensity’ chart can be found along with the current HOT Guidelines through the Transport Canada website: www.tc.gc.ca.

Use of Runway Visual Range (RVR) with the TC “Visibility in Snow vs Snowfall Intensity” Chart

There has been some confusion regarding the values indicated below the visibility (in parentheses) on the Snowfall Intensity Chart. The values indicated in parentheses refer to the visibility in metres and not an RVR.

RVR should not be used to determine visibility for the following reasons:

- a) RVR transmissometers were never intended to measure visibility with respect to snowfall intensity for use with holdover time guidelines.
- b) The RVR equipment is designed to provide pilots with an expected visual range along the runway, based on an associated runway edge and centerline lighting intensity. For a given obscuration phenomenon and precipitation intensity (fog, snow, etc.) the RVR will vary based on the selected runway lighting level. Therefore multiple RVR are possible for a given condition even though the meteorological conditions remain the same.
- c) Furthermore RVR’s in excess of 6000 ft are simply reported as 6000+. This level of resolution, only allows limited use of the Snowfall Intensity Chart (for example in darkness and at a temperature of -1°C and an RVR of 6000+, the only conclusion that can be drawn from the Snowfall Intensity Chart is that we are not in heavy snow, and that we could be in Moderate, Light or Very Light Snow conditions).

Varying Weather Conditions After Completion of Anti-Icing Procedure

During periods when the weather conditions are varying after completion of the anti-icing procedure, crews should reassess the previously selected holdover time. When doing so crews need to consider the following:

- 1) Improving weather conditions – if the snowfall intensity decreases, the original HOT should be retained;
- 2) Worsening weather conditions – if the snowfall intensity increases, a new lower HOT should be established and used.

Replace Sub-Paragraph 11.1.5, “Elapsed time is less than the lowest time in the HOT cell”, with the following:

Transport Canada has previously considered that, under an approved ground icing program, if the lowest time in a cell has NOT been exceeded for conditions covered by the Guidelines, there is no requirement to inspect the aircraft’s critical surfaces prior to commencing a takeoff.

This position was based on evidence gained during fluids testing. The HOT values are conservative for the lowest number in the cell, if:

- a) The conditions present are NOT in excess of those conditions represented by the table (e.g. for snow, it would be a moderate snow condition); and
- b) The impact of other factors (e.g. jet blast) has been considered and deemed not to affect the HOT.

If there is doubt surrounding the conditions associated with using the lowest time as a decision-making criterion, an inspection prior to takeoff would be prudent. This inspection should be conducted in accordance with the procedures described in the Air Operator's Approved Ground Icing Program.

Replace Sub-Paragraph 11.1.8, "Meteorological Conditions for which the HOT Guidelines are not applicable", with the following:

The HOT Guidelines do not include guidelines for all meteorological conditions. Holdover time guidelines have not been assessed for the following conditions: a) Hail; b) Moderate and Heavy Freezing Rain; and c) Heavy Snow.

Note: Operators need to assess whether operations can be safely conducted under these conditions.

Additionally, holdover time guidelines have not been assessed for Ice Pellets or Small Hail, since a formal protocol for this testing has not yet been developed and included in standard SAE testing methodologies and no visual failure criteria have yet been identified for these conditions. Instead, allowance times have been developed for operations during ice pellet conditions as a result of research carried out by Transport Canada and the FAA. As it has been determined small hail is equivalent to moderate ice pellets, allowance times are also provided for small hail conditions.

Replace entire contents of Sub-Paragraph 11.1.9, "Use of approved fluids", with the following:

11.1.9 Use of De/Anti-icing Fluids

The operator is ultimately responsible for ensuring that only fluids tested to SAE AMS 1424 or SAE AMS 1428 are applied when the HOT Guidelines will be utilized operationally.

The Transport Canada Holdover Time Guidelines document, published on an annual basis, contains lists of fluids that have been tested with respect to anti-icing performance (SAE AMS 1424 or SAE AMS 1428) and aerodynamic acceptance (SAE AMS 1424 or SAE AMS 1428) only.

Therefore, the end user is cautioned that they must confirm that other SAE AMS 1424 or SAE AMS 1428 technical requirement tests such as fluid stability, toxicity, materials compatibility, etc. have been conducted. The fluid manufacturer will supply all samples for testing and, is responsible for obtaining independent laboratory confirmation of conformance to these requirements of AMS 1424 or AMS 1428. The fluid manufacturer should provide certificates of conformance upon request.

Add Sub-Paragraph 11.1.12, "Type I HOT Guidelines for Aircraft with Critical Surfaces Constructed Using Composite Materials", as follows:

The recent introduction of new aircraft constructed primarily with composite materials required a review of Type I fluid holdover time performance when used on these aircraft. This review has shown that the holdover time performance of Type I fluids on composite surfaces is reduced when compared to aluminum surfaces. Type I fluid holdover time evaluations were conducted and holdover times have been developed for use with aircraft critical surfaces constructed primarily with composite materials.

It is not the intent that the composite holdover times be used on aircraft where previous experience has shown the acceptable use of aluminum holdover times (unless those aircraft have predominately or entirely composite critical surfaces). If there is any doubt, consult with the aircraft manufacturer to determine whether to use aluminum or composite holdover times.

Add Sub-Paragraph 11.1.13, “Longer Holdover Times for 75/25 Dilutions”, as follows:

For some brand-specific fluids, protection is increased in some cells when fluid concentration is reduced. The addition of certain quantities of water to some neat fluids can enhance their performance up to a certain point. Without knowing about this particular fluid mix phenomenon, an operator may think that the data presented in the tables are in error.

Add Sub-Paragraph 11.1.14, “Holdover Times for Non-Standard Dilutions of Type II, III and IV fluids”, as follows:

When a Type II, III, or IV fluid is diluted to other than the published 100/0, 75/25 or 50/50 dilutions, the more conservative holdover time and LOUT associated with either the dilution above or below the selected dilution are applicable.

For example:

- 1) The holdover time and LOUT of a 80/20 dilution would be the more conservative holdover time and LOUT of either the 100/0 or 75/25 dilutions;
- 2) The holdover time and LOUT of a 60/40 dilution would be the more conservative holdover time and LOUT of either the 75/25 or 50/50 dilutions.

Replace Sub-Paragraph 12.1.2, “Ice Pellet Conditions”, with the following:

Holdover time guidelines have not been assessed for ice pellets, since a formal protocol for ice pellet testing has not yet been developed and included in standard SAE testing methodologies and no visual failure criteria have been identified for ice pellet conditions.

However, comprehensive ice pellet research was conducted jointly by the research teams of the FAA and Transport Canada. This research consisted of extensive climatic chamber, wind tunnel, and live aircraft testing with ice pellets (light and moderate) and light ice pellets mixed with other forms of precipitation. Results of this research provide the basis for allowance times for operations in light and moderate ice pellets, as well as allowance times for operations in light ice pellets mixed with other forms of precipitation.

Replace Sub-Paragraph 12.1.6, “Cold Dry Snow Falling on a Cold Dry Wing”, with the following:**12.1.6 Cold Dry Snow (or Ice Crystals) Falling on a Cold Dry Wing**

Conditions are encountered whereby cold dry snow (or ice crystals) are falling onto the cold wing of an aircraft. The wind often causes the snow (or ice crystals) to swirl and move across the surface of the wing and it is evident that the snow (or ice crystals) is not adhering to the wing surface. Under these circumstances the application of deicing/anti-icing fluid to the wing of the aircraft would likely result in the snow (or ice crystals) sticking to the fluid. Under such operational conditions it may not be prudent to apply fluids to the wing.

However, if snow or ice crystals have accumulated at any location on the wing surface it must be removed prior to take-off. It cannot be assumed that snow or ice crystals on a wing will “blow off” during the take-off. For example, refueling with fuel warmer than the wing skin temperature may create a condition whereby previously non adhering contaminants may adhere to the wing surfaces.

Replace entire contents of Sub-Paragraph 12.1.7 “Frost”, with the following:**12.1.7 Frost**

Frost occurs frequently during winter operating conditions. Frost due to radiation cooling is a uniform thin white deposit of fine crystalline texture, which forms on exposed surfaces that are below freezing, generally on calm cloudless nights where the air at the surface is close to saturation. When the deposit is thin enough for surface features underneath the frost, such as paint lines, markings and lettering, to be distinguished it is often referred to as hoarfrost. Frost can also form on the upper or lower surfaces of the wing due to cold soaked fuel. Frost has the appearance of being a minor contaminant and therefore does not offer the same obvious signal of danger as do other types of contamination such as snow or ice. However, frost is an insidious threat to the safety of aircraft operations because it always adheres to the aircraft surface, is rough and causes significant lift degradation and increased drag.

12.1.7.1 Active Frost

Active frost is a condition when frost is forming. During active frost conditions, frost will form on an unprotected surface or re-form on a surface protected with de/anti-icing fluid where the holdover time has expired.

Frost forms whenever the exposed surface temperature cools below OAT to, or below, the frost point (not dew point). The mechanisms for cooling include:

- 1) radiation cooling; or
- 2) conductive cooling (due to cold soaked fuel).

If the exposed surface temperature is equal to or below the frost point, frost will begin to accrete on the surface. Once formed, residual accreted frost may remain after the active frost phase if the exposed surface temperature remains below freezing.

12.1.7.2 Dew Point and Frost Point

The dew point is the temperature at a given pressure to which air must be cooled to cause saturation. The dew point can occur below or above 0°C.

The frost point is the temperature, at or below 0°C (32°F), at which moisture in the air will condense as a layer of frost on an exposed surface. The frost point occurs between the OAT and dew point.

METAR does not report frost point, however it does report dew point. The frost point is higher (warmer) than the dew point for a given humidity in the air. The frost point and the dew point are the same at 0°C; at a dew point of -40°C, the frost point is 3.2°C warmer (-36.8°C). The following table provides further examples of the correlation between dew point and frost point.

Dew Point Temperature (°C)	Frost Point Temperature (°C)
0	0.0
-5	-4.4
-10	-8.9
-15	-13.5
-20	-18.0
-25	-22.7
-30	-27.3
-35	-32.1
-40	-36.8

12.1.7.3 Radiation Cooling

Radiation cooling will generally occur during clear sky (e.g. SKC, high FEW or high SCT), low wind (e.g. less than 10 knots), and low light (e.g. shade, at night or in low angle / obscured sun) conditions. These conditions will cause the exposed surface temperature to cool below the OAT. Once the exposed surface temperature cools to the frost point or below, active frost occurs.

Certain surface finishes and material compositions may be more susceptible to radiation cooling, and as a result, different areas of an aircraft may begin to accrete frost at different times. Radiation cooling can cause an exposed surface to cool several degrees below the OAT, therefore frost can form on an exposed surface at an OAT several degrees above 0°C.

Depending on conditions, time to frost formation may range from minutes to hours. As a result, a surface that appears free of frost during an early inspection may become contaminated later. When conditions are favorable for active frost formation, a direct inspection of critical surfaces conducted as close as possible to the departure time is recommended.

12.1.7.4 Cold Soaked Fuel Cooling

Cold soaked fuel cooling results from conductive cooling due to very cold fuel on board at destination or from refueling with fuel that may be cooler than the OAT. Cold soaked fuel conditions are highly variable and therefore, only direct surface temperature readings are accurate, but not available at most stations. Fuel temperature does not accurately predict cold soaked fuel conditions but may provide an initial indication, particularly in the period after landing and prior to fuelling. The presence of frost under the wing is a good indication of cold soaked fuel conditions.

In extreme cases, cold soaking may reduce the surface temperature below the fluid LOUT and cause aerodynamic performance degradation due to fluid freezing or the inability of the fluid to adequately flow off the treated surface.

12.1.7.5 Combined Radiation and Cold Soaked Fuel Cooling Effects

Cold soaked fuel cooling combined with radiation cooling effects can cause reductions in active frost holdover times. This is particularly true for Type I fluid holdover times as these are shorter in duration, and therefore use of a thickened anti-icing fluid should be considered.

12.1.7.6 De/Anti-Icing in Active Frost Conditions

Frost reforming after removal is an indication of active frost. During active frost, anti-icing protection is required and operations should be conducted in accordance with holdover time guidelines and minimum fluid quantity and temperature application procedures therein. Applications such as misting or mopping of Type I fluid may not provide adequate heat or fluid quantity to use the holdover times in active frost conditions.

In active frost conditions, deicing alone is insufficient, therefore, once the frost has been removed, a preventative anti-icing coating is required.

12.1.7.7 Fluid Holdover Times for Active Frost Conditions

Fluid holdover times in active frost conditions differ from holdover times in other conditions as they incorporate an allowance for the temperature differential (typically 6 to 8°C) between the OAT and the exposed surface temperature due to radiation cooling. As a result of this allowance, the OAT should be used to determine the appropriate active frost holdover time.

Active frost holdover times may be reduced in the presence of combined cooling effects or extreme surface cooling. In extreme cases, the surface temperature may be below the fluid LOUT and cause aerodynamic performance degradation due to fluid freezing or the inability of the fluid to adequately flow off the treated surface.

12.1.7.8 Frost on the Underside of the Wing

CAR 602.11(3) states: Notwithstanding subsection (12.1.7.9), a person may conduct a take-off in an aircraft that has frost adhering to the underside of its wings that is caused by cold-soaked fuel, if the take-off is conducted in accordance with the aircraft manufacturer's instructions for take-off under those conditions.

12.1.7.9 Frost on the Fuselage

Despite the requirement to clean contamination from critical surfaces, it is acceptable for aircraft, including those with aft fuselage mounted engines, to take-off when hoarfrost is adhering to the upper surface of the fuselage if it is the only remaining contaminant, provided all vents and ports are clear. Contact the aircraft manufacturer for further details.

Add Sub-Paragraph 12.1.9, "Hail and Small Hail", as follows:

The meteorological conditions "Hail" and "Small Hail" are different. Hail is a more intense condition for which holdover times do not exist. Small hail is a lighter condition, meteorologically equivalent to moderate ice pellets, for which allowance times are provided.

Add Sub-Paragraph 12.1.10, “METAR Code GS”, as follows:

The World Meteorological Organization (WMO) states METAR code GS is used for two meteorological conditions: “snow pellets” and “small hail.” However, investigation has determined that not all countries follow these guidelines. In the United States, METAR code GS is used exclusively for snow pellets; small hail is included in the METAR code for ice pellets (PL). In Canada and other countries, weather observers report METAR code GS in snow pellets and in small hail conditions, as recommended by the WMO. This is despite pilots’ guides in Canada stating METAR code GS is reported only in snow pellet conditions.

Different holdover times/allowance times apply in the two weather conditions that may be prevailing when METAR code GS is reported. If the weather condition is snow pellets, the snow holdover times are applicable. If the weather condition is small hail, the moderate ice pellets and small hail allowance times are applicable. If it is unknown which of the two weather conditions is prevailing, the moderate ice pellets and small hail allowance times are applicable, as these are more restrictive than the snow holdover times.

The following guidance should be used to ensure the correct holdover times/allowance times are used with METAR code GS:

- a) If operating in the United States and METAR code GS is reported, the snow holdover times should be used (because the weather condition is snow pellets).
- b) If operating in Canada or another country and METAR code GS is reported, the moderate ice pellet and small hail allowance times should be used (because the weather condition could be snow pellets or small hail and the small hail allowance times are more restrictive).
- c) If operating in Canada or another country and METAR code GS is reported and additional information is provided with the METAR that makes clear the weather condition is snow pellets and not small hail, the snow holdover times can be used.

Replace Sub-Paragraph 12.3 (5th paragraph), “Configuration During Deicing Procedures”, with the following:

Two possible options are: delaying slat/flap deployment until just prior to take-off; or deploying the devices prior to de/anti-icing so that the surfaces under these devices are treated. With the second option, the holdover time and allowance time will be reduced due to the steeper angles of the slat/flap in the deployed configuration.

Delaying the slat/flap deployment may be the preferred option for optimum protection from ice buildup. If it is necessary to remove contamination from the slats/flaps, it may be best to deploy the slats/flaps for deicing and anti-icing and then retract them prior to taxi. Consult the Aircraft Operating Manual and/or aircraft manufacturer for more details.

Replace Sub-Paragraph 12.6.7 (e), “Recommended “Clean Aircraft Concept” Practices”, with the following:

- e) The general rule for ground icing procedures is that the deicing and anti-icing processes must be done symmetrically. That is, whatever final treatment (i.e. same brand name fluid) is administered on one wing must be applied to the other wing for aerodynamic symmetry reasons.

Add the following definitions to Section 18 “Glossary”:*Lowest On-Wing Viscosity*

Lowest viscosity of a fluid for which the applicable holdover time table can still be used.

Maximum On-Wing Viscosity

Maximum viscosity of a fluid which is still aerodynamically acceptable.

HOLDOVER TIME (HOT) GUIDELINES FOR WINTER 2014-2015

Table 0	Active Frost Holdover Guidelines
Table 1-A	SAE Type I Fluid Holdover Guidelines on Aluminum Wing Surfaces
Table 1-C	SAE Type I Fluid Holdover Guidelines on Composite Wing Surfaces
Table 2-Generic	SAE Type II Fluid Holdover Guidelines
Table 2-A-E26	Type II Fluid Holdover Guidelines - ABAX Ecowing 26
Table 2-AS-CW II	Type II Fluid Holdover Guidelines - Aviation Shaanxi Hi-Tech Cleanwing II
Table 2-C-FLIGHT	Type II Fluid Holdover Guidelines - Clariant Safewing MP II FLIGHT
Table 2-C-FLIGHT+	Type II Fluid Holdover Guidelines - Clariant Safewing MP II FLIGHT PLUS
Table 2-CR-PG-II	Type II Fluid Holdover Guidelines - Cryotech Polar Guard II
Table 2-K-ABC-K+	Type II Fluid Holdover Guidelines - Kilfrost ABC-K Plus
Table 2-L-P250	Type II Fluid Holdover Guidelines - LNT Solutions P250
Table 2-N-FCY-2	Type II Fluid Holdover Guidelines - Newave Aerochemical FCY-2
Table 3	SAE Type III Fluid Holdover Guidelines
Table 4-Generic	SAE Type IV Fluid Holdover Guidelines
Table 4-A-AD-480	Type IV Fluid Holdover Guidelines - ABAX AD-480
Table 4-A-E-AD-49	Type IV Fluid Holdover Guidelines - ABAX Ecowing AD-49
Table 4-C-MF-04	Type IV Fluid Holdover Guidelines - Clariant Max Flight 04
Table 4-C-MF-SNEG	Type IV Fluid Holdover Guidelines - Clariant Max Flight Sneg
Table 4-C-LAUNCH	Type IV Fluid Holdover Guidelines - Clariant Safewing MP IV LAUNCH
Table 4-C-LAUNCH+	Type IV Fluid Holdover Guidelines - Clariant Safewing MP IV LAUNCH PLUS
Table 4-CR-PG	Type IV Fluid Holdover Guidelines - Cryotech Polar Guard
Table 4-CR-PG-A	Type IV Fluid Holdover Guidelines - Cryotech Polar Guard Advance
Table 4-D-E106	Type IV Fluid Holdover Guidelines - Dow Chemical UCAR™ Endurance EG106
Table 4-D-AD-480	Type IV Fluid Holdover Guidelines - Dow Chemical UCAR™ FlightGuard AD-480
Table 4-D-AD-49	Type IV Fluid Holdover Guidelines - Dow Chemical UCAR™ FlightGuard AD-49
Table 4-K-ABC-S	Type IV Fluid Holdover Guidelines - Kilfrost ABC-S
Table 4-K-ABC-S+	Type IV Fluid Holdover Guidelines - Kilfrost ABC-S Plus
Table 4-L-E450	Type IV Fluid Holdover Guidelines - LNT Solutions E450
Table 4-N-F-9311	Type IV Fluid Holdover Guidelines - Newave Aerochemical FCY 9311
Table 5	List of Fluids Tested for Anti-Icing Performance and Aerodynamic Acceptance
Table 6	SAE Type I De/Anti-icing Fluid Application Procedures
Table 7	SAE Type II, Type III and Type IV De/Anti-Icing Fluid Application Procedures
Table 8	Visibility in Snow vs. Snowfall Intensity Chart
Table 9	Lowest On-Wing Viscosity Values for De/Anti-Icing Fluids
Table 10	Lowest Operational Use Temperatures of De/Anti-Icing Fluids
Table 11	SAE Type III Ice Pellet and Small Hail Allowance Times
Table 12	SAE Type IV Ice Pellet and Small Hail Allowance Times

TABLE 0
ACTIVE FROST HOLDOVER GUIDELINES

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

Outside Air Temperature ^{1,2}		Approximate Holdover Times (hours:minutes)
Degrees Celsius	Degrees Fahrenheit	Active Frost
		Type I
-1 and above	30 and above	0:45 (0:35) ³
below -1 to -3	below 30 to 27	
below -3 to -10	below 27 to 14	
below -10 to -14	below 14 to 7	
below -14 to -21	below 7 to -6	
below -21 to LOU	below -6 to LOU	

Outside Air Temperature ²		Concentration Neat Fluid/Water (Volume %/ Volume %)	Approximate Holdover Times (hours:minutes)		
Degrees Celsius	Degrees Fahrenheit		Active Frost		
			Type II	Type III	Type IV
-1 and above	30 and above	100/0	8:00	2:00	12:00
		75/25	5:00	1:00	5:00
		50/50	3:00	0:30	3:00
below -1 to -3	below 30 to 27	100/0	8:00	2:00	12:00
		75/25	5:00	1:00	5:00
		50/50	1:30	0:30	3:00
below -3 to -10	below 27 to 14	100/0	8:00	2:00	10:00
		75/25	5:00	1:00	5:00
below -10 to -14	below 14 to 7	100/0	6:00	2:00	6:00
		75/25	1:00	1:00	1:00
below -14 to -21	below 7 to -6	100/0	6:00	2:00	6:00
below -21 to -25	below -6 to -13	100/0	2:00	2:00	4:00
Below -25	below -13	100/0	No Holdover Time Guidelines Exist		

NOTES

- 1 Type I Fluid / Water Mixture must be selected so that the freezing point of the mixture is at least 10°C (18°F) below outside air temperature.
- 2 Ensure that the lowest operational use temperature (LOU) is respected.
- 3 Value in parentheses is for composite surfaces.

CAUTIONS

- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 1-A

SAE TYPE I FLUID HOLDOVER GUIDELINES ON ALUMINUM WING SURFACES¹

This table applies to aircraft with critical surfaces constructed predominantly or entirely of aluminum materials that have demonstrated satisfactory use of these holdover times.
 THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

Outside Air Temperature ²		Approximate Holdover Times Under Various Weather Conditions (minutes)							
Degrees Celsius	Degrees Fahrenheit	Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
			Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	11 – 17	18	11 – 18	6 – 11	9 – 13	4 – 6	2 – 5	CAUTION: No holdover time guidelines exist
below -3 to -6	below 27 to 21	8 – 13	14	8 – 14	5 – 8	5 – 9	4 – 6		
below -6 to -10	below 21 to 14	6 – 10	11	6 – 11	4 – 6	4 – 7	2 – 5		
below -10	below 14	5 – 9	7	4 – 7	2 – 4				

NOTES

- 1 Type I Fluid / Water Mixture must be selected so that the freezing point of the mixture is at least 10°C (18°F) below outside air temperature.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover time guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 1-C

SAE TYPE I FLUID HOLDOVER GUIDELINES ON COMPOSITE WING SURFACES¹

These holdover times apply to newer aircraft with critical surfaces constructed predominantly or entirely of composite materials.
 THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER

Outside Air Temperature ²		Approximate Holdover Times Under Various Weather Conditions (minutes)							
Degrees Celsius	Degrees Fahrenheit	Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
			Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	9 – 16	12	6 – 12	3 – 6	8 – 13	4 – 6	1 – 5	CAUTION: No holdover time guidelines exist
below -3 to -6	below 27 to 21	6 – 8	11	5 – 11	2 – 5	5 – 9	4 – 6		
below -6 to -10	below 21 to 14	4 – 8	9	5 – 9	2 – 5	4 – 7	2 – 5		
below -10	below 14	4 – 7	7	4 – 7	2 – 4				

NOTES

- 1 Type I Fluid / Water Mixture must be selected so that the freezing point of the mixture is at least 10°C (18°F) below outside air temperature.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover time guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-Generic

SAE TYPE II FLUID HOLDOVER GUIDELINES¹

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	0:35 – 1:30	0:20 – 0:45	0:30 – 0:55	0:15 – 0:30	0:08 – 0:40	CAUTION: No holdover time guidelines exist
		75/25	0:25 – 1:00	0:15 – 0:30	0:20 – 0:45	0:10 – 0:25	0:05 – 0:25	
		50/50	0:15 – 0:30	0:05 – 0:15	0:08 – 0:15	0:05 – 0:09		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:05	0:15 – 0:30	0:20 – 0:45 ⁸	0:10 – 0:20 ⁸		
		75/25	0:25 – 0:50	0:10 – 0:20	0:15 – 0:30 ⁸	0:08 – 0:15 ⁸		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	0:15 – 0:35	0:15 – 0:30				

NOTES

- 1 Based on the lowest holdover times of the fluids listed in Table 5-2 and Table 5-4.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-A-E26

TYPE II FLUID HOLDOVER GUIDELINES¹
ABAX ECOWING 26

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	1:25 – 2:35	1:35	1:00 – 1:35	0:40 – 1:00	0:50 – 1:35	0:40 – 0:50	0:20 – 1:25	CAUTION: No holdover time guidelines exist
		75/25	1:05 – 1:55	1:15	0:45 – 1:15	0:25 – 0:45	0:45 – 1:05	0:25 – 0:35	0:10 – 1:00	
		50/50	0:30 – 0:45	0:40	0:20 – 0:40	0:10 – 0:20	0:15 – 0:25	0:08 – 0:10		
below -3 to -14	below 27 to 7	100/0	0:45 – 2:15	1:25	0:55 – 1:25	0:35 – 0:55	0:30 – 1:10 ⁸	0:15 – 0:35 ⁸		
		75/25	0:35 – 1:15	0:55	0:40 – 0:55	0:25 – 0:40	0:20 – 0:50 ⁸	0:15 – 0:25 ⁸		
below -14 to -25	below 7 to -13	100/0	0:25 – 0:45	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-AS-CW II

TYPE II FLUID HOLDOVER GUIDELINES¹
AVIATION SHAANXI HI-TECH CLEANWING II

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	0:55 – 1:50	0:30 – 0:55	0:35 – 1:05	0:25 – 0:35	0:10 – 0:55	CAUTION: No holdover time guidelines exist
		75/25	0:50 – 1:20	0:25 – 0:45	0:35 – 1:00	0:20 – 0:30	0:07 – 0:50	
		50/50	0:35 – 1:00	0:15 – 0:30	0:20 – 0:40	0:10 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:45 – 1:50	0:30 – 0:55	0:30 – 0:55 ⁸	0:20 – 0:25 ⁸		
		75/25	0:40 – 1:45	0:25 – 0:45	0:35 – 0:40 ⁸	0:20 – 0:25 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:20 – 0:50	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-C-FLIGHT

TYPE II FLUID HOLDOVER GUIDELINES¹
CLARIANT SAFEWING MP II FLIGHT

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	3:30 – 4:00	2:00	1:35 – 2:00	1:00 – 1:35	1:20 – 2:00	0:45 – 1:25	0:10 – 1:30	
		75/25	1:50 – 2:45	2:00	1:20 – 2:00	0:40 – 1:20	1:10 – 1:30	0:30 – 0:55	0:06 – 0:50	
		50/50	0:55 – 1:45	0:45	0:25 – 0:45	0:10 – 0:25	0:20 – 0:30	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:55 – 1:45	1:50	1:05 – 1:50	0:40 – 1:05	0:35 – 1:30 ⁸	0:25 – 0:45 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:25 – 1:05	1:20	0:40 – 1:20	0:20 – 0:40	0:25 – 1:10 ⁸	0:20 – 0:35 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:30 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-C-FLIGHT+

TYPE II FLUID HOLDOVER GUIDELINES¹
CLARIANT SAFEWING MP II FLIGHT PLUS

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
-3 and above	27 and above	100/0	2:40 – 4:00	0:50 – 1:50	1:25 – 2:00	0:45 – 1:00	0:15 – 2:00	CAUTION: No holdover time guidelines exist
		75/25	2:35 – 4:00	1:00 – 1:45	1:35 – 2:00	0:50 – 1:15	0:15 – 1:15	
		50/50	1:05 – 2:20	0:15 – 0:25	0:30 – 1:05	0:15 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:40 – 2:20	0:35 – 1:15	0:35 – 1:25 ⁸	0:35 – 0:55 ⁸		
		75/25	0:30 – 1:45	0:55 – 1:40	0:25 – 1:10 ⁸	0:30 – 0:45 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:20 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-CR-PG-II

TYPE II FLUID HOLDOVER GUIDELINES¹
CRYOTECH POLAR GUARD II

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:50 – 4:00	2:00	1:50 – 2:00	1:20 – 1:50	1:35 – 2:00	1:15 – 1:30	0:15 – 2:00	CAUTION: No holdover time guidelines exist
		75/25	2:30 – 4:00	2:00	1:20 – 2:00	0:45 – 1:20	1:40 – 2:00	0:40 – 1:10	0:09 – 1:40	
		50/50	0:50 – 1:25	1:20	0:35 – 1:20	0:15 – 0:35	0:20 – 0:45	0:09 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:55 – 2:30	1:45	1:15 – 1:45	0:55 – 1:15	0:35 – 1:35 ⁸	0:35 – 0:45 ⁸		
		75/25	0:40 – 1:30	1:45	1:00 – 1:45	0:35 – 1:00	0:25 – 1:05 ⁸	0:35 – 0:45 ⁸		
below -14 to -30.5	below 7 to -22.9	100/0	0:25 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-K-ABC-K+

TYPE II FLUID HOLDOVER GUIDELINES¹
KILFROST ABC-K PLUS

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	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	1:40 – 2:30	0:35 – 1:10	1:25 – 2:00	0:50 – 1:10	0:15 – 2:00	
		50/50	0:35 – 1:05	0:07 – 0:15	0:20 – 0:30	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:30 – 1:05	0:50 – 1:25	0:25 – 1:00 ⁸	0:15 – 0:35 ⁸		
		75/25	0:25 – 1:25	0:35 – 1:05	0:20 – 0:55 ⁸	0:09 – 0:30 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:30 – 0:55	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-L-P250

**TYPE II FLUID HOLDOVER GUIDELINES¹
LNT SOLUTIONS P250**

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:10 – 4:00	2:00	1:45 – 2:00	0:55 – 1:45	1:35 – 2:00	0:50 - 1:25	0:15 – 2:00	CAUTION: No holdover time guidelines exist
		75/25	1:50 – 2:35	2:00	1:25 – 2:00	0:45 – 1:25	1:20 – 1:35	0:40 – 1:00	0:10 – 1:50	
		50/50	0:35 – 0:50	0:35	0:30 – 0:35	0:15 – 0:30	0:20 – 0:35	0:15 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:45 – 2:20	2:00	1:40 – 2:00	0:50 – 1:40	0:25 – 1:20 ⁸	0:25 – 0:35 ⁸		
		75/25	0:35 – 1:45	2:00	1:25 – 2:00	0:45 – 1:25	0:20 – 1:15 ⁸	0:20 – 0:30 ⁸		
below -14 to LOUT	below 7 to LOUT	100/0	0:20 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 2-N-FCY-2

TYPE II FLUID HOLDOVER GUIDELINES¹
NEWAVE AEROCHEMICAL FCY-2

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

Outside Air Temperature ²		Type II Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
-3 and above	27 and above	100/0	1:15 – 2:25	0:30 – 0:55	0:35 – 1:05	0:25 – 0:35	0:08 – 0:45	CAUTION: No holdover time guidelines exist
		75/25	0:50 – 1:30	0:20 – 0:40	0:25 – 0:45	0:15 – 0:25	0:05 – 0:25	
		50/50	0:25 – 0:35	0:15 – 0:25	0:10 – 0:20	0:07 – 0:10		
below -3 to -14	below 27 to 7	100/0	0:45 – 1:30	0:15 – 0:30	0:20 – 0:45 ⁸	0:15 – 0:20 ⁸		
		75/25	0:30 – 1:05	0:10 – 0:20	0:15 – 0:30 ⁸	0:08 – 0:15 ⁸		
below -14 to -28	below 7 to -18.4	100/0	0:25 – 0:35	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 3

SAE TYPE III FLUID HOLDOVER GUIDELINES¹

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

Outside Air Temperature ²		Type III Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	20 – 40	35	20 – 35	10 – 20	10 – 20	8 – 10	6 – 20	CAUTION: No holdover time guidelines exist
		75/25	15 – 30	25	15 – 25	8 – 15	8 – 15	6 – 10	2 – 10	
		50/50	10 – 20	15	8 – 15	4 – 8	5 – 9	4 – 6		
below -3 to -10	below 27 to 14	100/0	20 – 40	30	15 – 30	9 – 15	10 – 20	8 – 10		
		75/25	15 – 30 ⁸	25 ⁸	10 – 25 ⁸	7 – 10 ⁸	9 – 12 ⁸	6 – 9 ⁸		
below -10	below 14	100/0	20 – 40	30	15 – 30	8 – 15				

NOTES

- 1 Fluid must be applied unheated to use these holdover times. No holdover times exist for Type III fluid applied heated.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type III fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 11 provides allowance times for ice pellets and small hail).
- 8 For aircraft with a take-off profile conforming to the low speed aerodynamic test criterion (refer to Section 8.1.6.1 f) of TP 14052E), these holdover times only apply to outside air temperatures from below -3°C to -9°C (below 27°F to 15.8°F). If uncertain whether the aircraft performance conforms to this criterion, consult the aircraft manufacturer.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-Generic

SAE TYPE IV FLUID HOLDOVER GUIDELINES¹

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
-3 and above	27 and above	100/0	1:50 – 2:55	0:35 – 1:10	0:50 – 1:30	0:35 – 0:55	0:10 – 1:15	CAUTION: No holdover time guidelines exist
		75/25	1:05 – 1:45	0:30 – 0:55	0:45 – 1:10	0:30 – 0:45	0:09 – 0:50	
		50/50	0:20 – 0:35	0:07 – 0:15	0:15 – 0:20	0:08 – 0:10		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:20	0:25 – 0:50	0:20 – 1:00 ⁸	0:10 – 0:25 ⁸		
		75/25	0:25 – 0:50 ⁹	0:20 – 0:40 ⁹	0:15 – 1:05 ^{8,9}	0:10 – 0:25 ^{8,9}		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	0:15 – 0:40 ¹⁰	0:15 – 0:30 ¹⁰				

NOTES

- 1 Based on the lowest holdover times of the fluids listed in Table 5-4.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.
- 9 For Cryotech Polar Guard the temperature is limited to -5.5°C (22.1°F). If the fluid is unknown, these holdover times only apply down to -5.5°C (22.1°F).
- 10 For Cryotech Polar Guard and Clariant Max Flight 04, the temperature is limited to -23.5°C (-10.3°F). If the fluid is unknown, these holdover times only apply down to -23.5°C (-10.3°F).

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-A-AD-480

TYPE IV FLUID HOLDOVER GUIDELINES¹
ABAX AD-480

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	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	1:30 – 2:45	0:30 – 1:05	0:50 – 1:15	0:30 – 0:45	0:10 – 1:15	
		50/50	0:30 – 0:45	0:09 – 0:20	0:15 – 0:25	0:09 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:20	0:30 – 0:55	0:25 – 1:20 ⁸	0:15 – 0:30 ⁸		
		75/25	0:25 – 0:50	0:20 – 0:45	0:25 – 1:05 ⁸	0:15 – 0:30 ⁸		
below -14 to -26	below 7 to -14.8	100/0	0:15 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-A-E-AD-49

TYPE IV FLUID HOLDOVER GUIDELINES¹
ABAX ECOWING AD-49

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	3:20 – 4:00	2:00	1:50 – 2:00	1:10 – 1:50	1:25 – 2:00	1:00 – 1:25	0:10 – 1:55	
		75/25	2:25 – 4:00	2:00	1:40 – 2:00	1:20 – 1:40	1:55 – 2:00	0:50 – 1:30	0:10 – 1:40	
		50/50	0:25 – 0:50	0:40	0:25 – 0:40	0:15 – 0:25	0:15 – 0:30	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:35	2:00	1:50 – 2:00	1:10 – 1:50	0:25 – 1:25 ⁸	0:20 – 0:25 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:30 – 1:10	2:00	1:40 – 2:00	1:20 – 1:40	0:15 – 1:05 ⁸	0:15 – 0:25 ⁸		
below -14 to -26	below 7 to -14.8	100/0	0:25 – 0:40	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-C-MF-04

TYPE IV FLUID HOLDOVER GUIDELINES¹
CLARIANT MAX FLIGHT 04

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:40 – 4:00	2:00	2:00 – 2:00	1:25 – 2:00	2:00 – 2:00	1:10 – 1:30	0:20 – 2:00	
		75/25								
		50/50								
below -3 to -14	below 27 to 7	100/0	0:50 – 2:30	2:00	1:10 – 2:00	0:35 – 1:10	0:25 – 1:30 ⁸	0:20 – 0:40 ⁸	CAUTION: No holdover time guidelines exist	
		75/25								
below -14 to -23.5	below 7 to -10.3	100/0	0:20 – 0:45	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-C-MF-SNEG

TYPE IV FLUID HOLDOVER GUIDELINES¹
CLARIANT MAX FLIGHT SNEG

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:25 – 4:00	2:00	1:40 – 2:00	1:05 – 1:40	2:00 – 2:00	0:50 – 1:40	0:20 – 1:30	CAUTION: No holdover time guidelines exist
		75/25	4:00 – 4:00	2:00	1:30 – 2:00	0:55 – 1:30	1:30 – 2:00	1:05 – 1:20	0:15 – 1:45	
		50/50	1:30 – 3:30	1:45	0:45 – 1:45	0:20 – 0:45	0:35 – 1:10	0:15 – 0:30		
below -3 to -14	below 27 to 7	100/0	0:45 – 2:20	2:00	1:15 – 2:00	0:45 – 1:15	0:30 – 1:25 ⁸	0:25 – 0:40 ⁸		
		75/25	0:30 – 1:25	1:40	1:00 – 1:40	0:40 – 1:00	0:20 – 1:05 ⁸	0:20 – 0:40 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:20 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-C-LAUNCH

TYPE IV FLUID HOLDOVER GUIDELINES¹
CLARIANT SAFEWING MP IV LAUNCH

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	4:00 – 4:00	2:00	1:45 – 2:00	1:05 – 1:45	1:30 – 2:00	1:00 – 1:40	0:15 – 1:40	
		75/25	3:40 – 4:00	2:00	1:45 – 2:00	1:00 – 1:45	1:40 – 2:00	0:45 – 1:15	0:10 – 1:45	
		50/50	1:25 – 2:45	1:25	0:45 – 1:25	0:25 – 0:45	0:30 – 0:50	0:20 – 0:25		
below -3 to -14	below 27 to 7	100/0	1:00 – 1:55	2:00	1:20 – 2:00	0:50 – 1:20	0:35 – 1:40 ⁸	0:25 – 0:45 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:40 – 1:20	2:00	1:25 – 2:00	0:45 – 1:25	0:25 – 1:10 ⁸	0:25 – 0:45 ⁸		
below -14 to -28.5	below 7 to -19.3	100/0	0:30 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-C-LAUNCH+

TYPE IV FLUID HOLDOVER GUIDELINES¹
CLARIANT SAFEWING MP IV LAUNCH PLUS

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	3:55 – 4:00	2:00	2:00 – 2:00	0:55 – 2:00	2:00 – 2:00	1:00 – 2:00	0:20 – 2:00	
		75/25	3:55 – 4:00	2:00	1:55 – 2:00	0:50 – 1:55	2:00 – 2:00	1:20 – 1:25	0:20 – 1:50	
		50/50	1:15 – 1:50	1:35	0:45 – 1:35	0:20 – 0:45	0:25 – 1:00	0:15 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:55 – 2:15	2:00	1:25 – 2:00	0:40 – 1:25	0:25 – 1:35 ⁸	0:25 – 0:40 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:40 – 2:00	2:00	1:15 – 2:00	0:30 – 1:15	0:20 – 1:05 ⁸	0:20 – 0:30 ⁸		
below -14 to -29	below 7 to -20.2	100/0	0:25 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-CR-PG

TYPE IV FLUID HOLDOVER GUIDELINES¹
CRYOTECH POLAR GUARD

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	2:15 – 3:30	0:50 – 1:30	1:15 – 2:00	0:50 – 1:15	0:15 – 1:25	CAUTION: No holdover time guidelines exist
		75/25	1:40 – 2:40	0:35 – 1:10	1:05 – 1:25	0:35 – 1:00	0:10 – 1:15	
		50/50	0:25 – 0:40	0:10 – 0:15	0:15 – 0:25	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:45 – 1:45	0:30 – 0:55	0:25 – 1:10 ⁸	0:15 – 0:35 ⁸		
		75/25	0:35 – 1:30 ⁹	0:20 – 0:40 ⁹	0:25 – 1:05 ⁹	0:20 – 0:30 ⁹		
below -14 to -23.5	below 7 to -10.3	100/0	0:20 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.
- 9 These holdover times only apply to outside air temperatures to -5.5°C (22.1°F) and above.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-CR-PG-A

TYPE IV FLUID HOLDOVER GUIDELINES¹
CRYOTECH POLAR GUARD ADVANCE

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:50 – 4:00	2:00	1:50 – 2:00	1:20 – 1:50	1:35 – 2:00	1:15 – 1:30	0:15 – 2:00	
		75/25	2:30 – 4:00	2:00	1:20 – 2:00	0:45 – 1:20	1:40 – 2:00	0:40 – 1:10	0:09 – 1:40	
		50/50	0:50 – 1:25	1:20	0:35 – 1:20	0:15 – 0:35	0:20 – 0:45	0:09 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:55 – 2:30	1:45	1:15 – 1:45	0:55 – 1:15	0:35 – 1:35 ⁸	0:35 – 0:45 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:40 – 1:30	1:45	1:00 – 1:45	0:35 – 1:00	0:25 – 1:05 ⁸	0:35 – 0:45 ⁸		
below -14 to -30.5	below 7 to -22.9	100/0	0:25 – 0:50	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-D-E106

TYPE IV FLUID HOLDOVER GUIDELINES¹
DOW CHEMICAL UCAR™ ENDURANCE EG106

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:05 – 3:10	2:00	1:20 – 2:00	0:40 – 1:20	1:10 – 2:00	0:50 – 1:15	0:20 – 2:00	CAUTION: No holdover time guidelines exist
		75/25								
		50/50								
below -3 to -14	below 27 to 7	100/0	1:50 – 3:20	2:00	1:05 – 2:00	0:30 – 1:05	0:55 – 1:50 ⁸	0:45 – 1:10 ⁸		
		75/25								
below -14 to -27	below 7 to -16.6	100/0	0:30 – 1:05	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-D-AD-480

TYPE IV FLUID HOLDOVER GUIDELINES¹
DOW CHEMICAL UCAR™ FLIGHTGUARD AD-480

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	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	1:30 – 2:45	0:30 – 1:05	0:50 – 1:15	0:30 – 0:45	0:10 – 1:15	
		50/50	0:30 – 0:45	0:09 – 0:20	0:15 – 0:25	0:09 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:20	0:30 – 0:55	0:25 – 1:20 ⁸	0:15 – 0:30 ⁸		
		75/25	0:25 – 0:50	0:20 – 0:45	0:25 – 1:05 ⁸	0:15 – 0:30 ⁸		
below -14 to -26	below 7 to -14.8	100/0	0:15 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-D-AD-49

TYPE IV FLUID HOLDOVER GUIDELINES¹
DOW CHEMICAL UCAR™ FLIGHTGUARD AD-49

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	3:20 – 4:00	2:00	1:50-2:00	1:10 – 1:50	1:25 – 2:00	1:00 – 1:25	0:10 – 1:55	CAUTION: No holdover time guidelines exist
		75/25	2:25 – 4:00	2:00	1:40-2:00	1:20 – 1:40	1:55 – 2:00	0:50 – 1:30	0:10 – 1:40	
		50/50	0:25 – 0:50	0:40	0:25-0:40	0:15 – 0:25	0:15 – 0:30	0:10 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:20 – 1:35	2:00	1:50-2:00	1:10 – 1:50	0:25 – 1:25 ⁸	0:20 – 0:25 ⁸		
		75/25	0:30 – 1:10	2:00	1:40-2:00	1:20 – 1:40	0:15 – 1:05 ⁸	0:15 – 0:25 ⁸		
below -14 to -26	below 7 to -14.8	100/0	0:25 – 0:40	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-K-ABC-S
TYPE IV FLUID HOLDOVER GUIDELINES¹
KILFROST ABC-S

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	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	1:05 – 1:45	0:30 – 0:55	0:45 – 1:10	0:35 – 0:50	0:10 – 0:50	
		50/50	0:20 – 0:35	0:07 – 0:15	0:15 – 0:20	0:08 – 0:10		
below -3 to -14	below 27 to 7	100/0	0:45 – 2:05	0:45 – 1:20	0:20 – 1:00 ⁸	0:10 – 0:30 ⁸		
		75/25	0:25 – 1:00	0:25 – 0:50	0:20 – 1:10 ⁸	0:10 – 0:35 ⁸		
below -14 to -28	below 7 to -18.4	100/0	0:20 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-K-ABC-S+

**TYPE IV FLUID HOLDOVER GUIDELINES¹
KILFROST ABC-S PLUS**

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	2:10 – 4:00	2:00	2:00 – 2:00	1:15 – 2:00	1:50 – 2:00	1:05 – 2:00	0:25 – 2:00	
		75/25	1:25 – 2:40	2:00	1:15 – 2:00	0:45 – 1:15	1:00 – 1:20	0:30 – 0:50	0:10 – 1:20	
		50/50	0:30 – 0:55	1:00	0:30 – 1:00	0:15 – 0:30	0:15 – 0:40	0:15 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:55 – 3:30	2:00	1:45 – 2:00	1:00 – 1:45	0:25 – 1:35 ⁸	0:20 – 0:30 ⁸	CAUTION: No holdover time guidelines exist	
		75/25	0:45 – 1:50	1:45	1:00 – 1:45	0:35 – 1:00	0:20 – 1:10 ⁸	0:15 – 0:25 ⁸		
below -14 to -28	below 7 to -18.4	100/0	0:40 – 1:00	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-L-E450

**TYPE IV FLUID HOLDOVER GUIDELINES¹
LNT SOLUTIONS E450**

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					Other ⁷
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ^{3,4}	Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	
-3 and above	27 and above	100/0	1:50 – 2:55	0:35 – 1:10	1:35 – 2:00	0:55 – 1:20	0:25 – 2:00	CAUTION: No holdover time guidelines exist
		75/25						
		50/50						
below -3 to -14	below 27 to 7	100/0	1:30 – 3:55	0:25 – 0:50	1:45 – 2:00 ⁸	1:05 – 1:40 ⁸		
		75/25						
below -14 to LOUT	below 7 to LOUT	100/0	0:35 – 1:05	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 4-N-F-9311

TYPE IV FLUID HOLDOVER GUIDELINES¹
NEWAVE AEROCHEMICAL FCY 9311

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

Outside Air Temperature ²		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³			Freezing Drizzle ⁵	Light Freezing Rain	Rain on Cold Soaked Wing ⁶	Other ⁷
				Very Light ⁴	Light ⁴	Moderate				
-3 and above	27 and above	100/0	1:55 – 4:00	2:00	1:10 – 2:00	0:35 – 1:10	1:10 – 2:00	0:40 – 1:05	0:15–1:25	
		75/25								
		50/50								
below -3 to -14	below 27 to 7	100/0	0:35 – 2:05	1:35	0:50 – 1:35	0:25 – 0:50	0:35 – 1:20 ⁸	0:20 – 0:35 ⁸	CAUTION: No holdover time guidelines exist	
		75/25								
below -14 to -29.5	below 7 to -21.1	100/0	0:30 – 0:55	0:40	0:30 – 0:40	0:15 – 0:30				

NOTES

- 1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
- 2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
- 3 To determine snowfall intensity, the visibility in snow vs. snowfall intensity table (Table 8) is required.
- 4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 5 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 6 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 12 provides allowance times for ice pellets and small hail).
- 8 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.
- 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.
- Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 5

LIST OF FLUIDS TESTED FOR ANTI-ICING PERFORMANCE AND AERODYNAMIC ACCEPTANCE (2014-2015)

Table 5-1: Tested Type I De/Anti-icing Fluids ⁽¹⁾		
COMPANY NAME	FLUID NAME	EXPIRY ⁽²⁾ (Y-M-D)
ABAX Industries	DE-950	18-05-01
<i>ABAX Industries</i>	<i>DE-950 Colorless</i>	12-06-26 ⁽³⁾
AllClear Systems LLC	Lift-Off P-88	18-06-11
AllClear Systems LLC	Lift-Off E-188	15-05-29
Arcton Ltd.	Arctica DG ready-to-use	17-07-15
Arcton Ltd.	Arctica DG 91 Concentrate	15-07-25
Aviation Shaanxi High-Tech Physical Co. Ltd.	Cleanwing I	15-12-19
Aviation Xi'an High-Tech Physical Co. Ltd.	KHF-1	15-08-16
Baltic Ground Services	DEFROSOL ADF	15-03-18
<i>Beijing Phoenix Air Traffic Product Development and Trading Co.</i>	<i>CBSX-1</i>	12-04-21 ⁽³⁾
Beijing Wangye Aviation Chemical Product Co Ltd.	KLA-1	15-08-25
Beijing Yadilite Aviation Chemical Product Co. Ltd	YD-101 Type I	17-05-27
CHEMCO Inc.	CHEMR EG I	16-03-25
CHEMCO Inc.	CHEMR REG I	16-07-08
<i>Clariant Produkte (Deutschland) GmbH</i>	<i>EcoFlo Concentrate</i>	13-07-06 ⁽³⁾
<i>Clariant Produkte (Deutschland) GmbH</i>	<i>EcoFlo 2 Concentrate</i>	13-07-25 ⁽³⁾
Clariant Produkte (Deutschland) GmbH	Octaflo EF Concentrate	18-03-20
<i>Clariant Produkte (Deutschland) GmbH</i>	<i>Octaflo EF-80</i>	13-12-21 ⁽³⁾
Clariant Produkte (Deutschland) GmbH	Octaflo EG Concentrate	13-12-11 ⁽⁴⁾
Clariant Produkte (Deutschland) GmbH	Octaflo Lyod	16-02-11
<i>Clariant Produkte (Deutschland) GmbH</i>	<i>Safewing EG I 1996</i>	12-06-10 ⁽³⁾
Clariant Produkte (Deutschland) GmbH	Safewing EG I 1996 (88)	15-10-19
Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO	16-06-26
Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO (80)	16-07-09
Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO (80) Premix 55% i.g. ready-to-use	15-07-15
Clariant Produkte (Deutschland) GmbH	Safewing MP I ECO PLUS (80)	15-03-15
Cryotech Deicing Technology	Polar Plus [®] Concentrate	16-01-16
Cryotech Deicing Technology	Polar Plus [®] LT	16-03-13
Cryotech Deicing Technology	Polar Plus [®] (80)	17-09-12
Deicing Solutions LLC	Safetemp [®] ES Plus	16-08-07
Dow Chemical Company	UCAR [™] Aircraft Deicing Fluid Concentrate	15-09-09
Dow Chemical Company	UCAR [™] ADF XL54	17-01-18
Dow Chemical Company	UCAR [™] PG Aircraft Deicing Fluid Concentrate	15-12-08
See next page for additional Type I fluids and Table 5-1 notes and caution		

TABLE 5 (cont.)

LIST OF FLUIDS TESTED FOR ANTI-ICING PERFORMANCE AND AERODYNAMIC ACCEPTANCE (2014-2015)

Table 5-1: Tested Type I De/Anti-icing Fluids (cont.) ⁽¹⁾		
COMPANY NAME	FLUID NAME	EXPIRY ⁽²⁾ (Y-M-D)
<i>Dow Chemical Company</i>	<i>UCAR™ PG ADF Dilute 55/45</i>	<i>12-02-05 ⁽³⁾</i>
Heilongjiang Hangjie Aero-chemical Technology Co. Ltd. (formerly Harbin Aeroclean Aviation Tech Co. Ltd.)	HJF-1	17-10-02
HOC Industries	SafeTemp® ES Plus	16-08-07
Hokkaido NOF Corporation	Fever Snow AG	17-07-15
Inland Technologies CANADA Inc.	Duragly-E Concentrate	15-02-04
Inland Technologies CANADA Inc.	Duragly-P Concentrate	15-02-04
Kilfrost Limited	DF Plus	14-07-30 ⁽⁴⁾
Kilfrost Limited	DF Plus (80)	14-07-30 ⁽⁴⁾
Kilfrost Limited	DF Plus (88)	14-07-30 ⁽⁴⁾
Kilfrost Limited	DF ^{sustain} ™	15-08-08
LNT Solutions	E188	17-10-01
LNT Solutions	P180	17-10-04
LNT Solutions	P188	13-09-21 ⁽⁴⁾
Newave Aerochemical Co. Ltd.	FCY-1A	15-05-16
Newave Aerochemical Co. Ltd.	FCY-1Bio ⁺	16-07-08
Shaanxi Cleanway Aviation Chemical Co., Ltd	Cleansurface I	17-09-12
Shaanxi Cleanway Aviation Chemical Co., Ltd	Cleansurface I-BIO	18-07-11

⁽¹⁾ Concentrate fluids have also been tested at 50/50 (glycol/water) dilution.

⁽²⁾ Expiry date is the earlier expiry date of the Aerodynamic Test(s) or Water Spray Endurance Test. Fluids that are tested after the issuance of this list will appear in a later update.

⁽³⁾ Fluids listed in italics have expired and will be removed from this listing four years after expiry.

⁽⁴⁾ Currently in the test/re-test process.

CAUTION: This table lists fluids that have been tested with respect to anti-icing performance and aerodynamic acceptance (SAE AMS1424 §3.5.2 and AMS1424 §3.5.3) only. These tests were conducted by Anti-icing Materials International Laboratory: www.ugac.ca/amil. The end user is responsible for contacting the fluid manufacturer to confirm all other SAE AMS1424 technical requirement tests, such as fluid stability, toxicity, materials compatibility, etc. have been conducted.

TABLE 5 (cont.)

LIST OF FLUIDS TESTED FOR ANTI-ICING PERFORMANCE AND AERODYNAMIC ACCEPTANCE (2014-2015)

Table 5-2: Tested Type II De/Anti-icing Fluids		
COMPANY NAME	FLUID NAME	EXPIRY ⁽¹⁾ (Y-M-D)
ABAX Industries	Ecowing 26	15-05-15
Aviation Shaanxi Hi-Tech Physical Chemical Co. Ltd.	Cleanwing II	15-08-08
<i>Clariant Produkte (Deutschland) GmbH</i>	<i>Safewing MP II 1951</i>	<i>11-05-20 ⁽²⁾</i>
Clariant Produkte (Deutschland) GmbH	Safewing MP II FLIGHT	16-05-14
Clariant Produkte (Deutschland) GmbH	Safewing MP II FLIGHT PLUS	16-02-28
Cryotech Deicing Technology	Polar Guard II	15-07-15
Kilfrost Limited	ABC-3	14-09-27 ⁽³⁾
Kilfrost Limited	ABC-K Plus	14-11-15 ⁽³⁾
LNT Solutions	P250	Y-M-D ⁽³⁾
Newave Aerochemical Co. Ltd.	FCY-2	15-06-26

Table 5-3: Tested Type III De/Anti-icing Fluids		
COMPANY NAME	FLUID NAME	EXPIRY ⁽¹⁾ (Y-M-D)
Clariant Produkte (Deutschland) GmbH	Safewing MP III 2031 ECO	15-08-15

Table 5-4: Tested Type IV De/Anti-icing Fluids		
COMPANY NAME	FLUID NAME	EXPIRY ⁽¹⁾ (Y-M-D)
<i>ABAX Industries</i>	<i>AD-480</i>	<i>11-07-17 ⁽²⁾</i>
ABAX Industries	Ecowing AD-49	16-06-02
Clariant Produkte (Deutschland) GmbH	Max Flight 04	16-07-23
Clariant Produkte (Deutschland) GmbH	Max Flight Sneg	16-02-20
Clariant Produkte (Deutschland) GmbH	Safewing MP IV LAUNCH	16-06-02
Clariant Produkte (Deutschland) GmbH	Safewing MP IV LAUNCH PLUS	15-07-19
<i>Cryotech Deicing Technology</i>	<i>Polar Guard</i>	<i>12-08-30 ⁽²⁾</i>
Cryotech Deicing Technology	Polar Guard Advance	15-07-15
Dow Chemical Company	UCAR™ Endurance EG106 De/Anti-Icing Fluid	15-07-25
<i>Dow Chemical Company</i>	<i>UCAR™ FlightGuard AD-480</i>	<i>12-06-15 ⁽²⁾</i>
Dow Chemical Company	UCAR™ FlightGuard AD-49	15-05-15
<i>Kilfrost Limited</i>	<i>ABC-S</i>	<i>11-07-06 ⁽²⁾</i>
Kilfrost Limited	ABC-S Plus	15-06-27
LNT Solutions	E450	Y-M-D ⁽³⁾
Newave Aerochemical Co. Ltd	FCY 9311	15-12-20

⁽¹⁾ Expiry date is the earlier expiry date of the Aerodynamic Test(s) or Water Spray Endurance Test. Fluids that are tested after the issuance of this list will appear in a later update.

⁽²⁾ Fluids listed in italics have expired and will be removed from this listing four years after expiry.

⁽³⁾ Currently in the test/re-test process.

CAUTION: This table lists fluids that have been tested with respect to anti-icing performance and aerodynamic acceptance (SAE AMS1428 §3.2.5 and AMS1428 §3.2.4) only. These tests were conducted by Anti-icing Materials International Laboratory: www.ugac.ca/amil. The end user is responsible for contacting the fluid manufacturer to confirm all other SAE AMS1428 technical requirement tests, such as fluid stability, toxicity, materials compatibility, etc. have been conducted.

TABLE 6

SAE TYPE I DE/ANTI-ICING FLUID APPLICATION PROCEDURES

Guidelines for the application of SAE Type I fluid mixtures at minimum concentrations for the prevailing outside air temperature (OAT)

Outside Air Temperature (OAT) ¹	One-Step Procedure De/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing ²
-3°C (27°F) and above	Heated mix of fluid and water with a freezing point of at least 10°C (18°F) below OAT	Heated water or a heated mix of fluid and water	Heated mix of fluid and water with a freezing point of at least 10°C (18°F) below OAT
Below -3°C (27°F)		Freezing point of heated fluid mixture shall not be more than 3°C (5°F) above OAT	

- 1 Fluids must not be used at temperatures below their lowest operational use temperature (LOUT).
- 2 To be applied before first step fluid freezes, typically within 3 minutes. (This time may be higher than 3 minutes in some conditions, but potentially lower in heavy precipitation, colder temperatures, or for critical surfaces constructed of composite materials. If necessary, the second step shall be applied area by area.)

NOTES

- Temperature of water or fluid/water mixtures shall be at least 60°C (140°F) at the nozzle. Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
- To use Type I holdover time guidelines in all conditions including active frost, at least 1 litre/m² (~ 2 gal./100 sq. ft.) must be applied to the deiced surfaces.
- This table is applicable for the use of Type I holdover time guidelines in all conditions including active frost. 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 its freezing point buffer of 10°C (18°F).

CAUTION

- **Wing skin temperatures may differ and in some cases may be lower than outside air temperatures; a stronger mix (more glycol) may be needed under these conditions.**

TABLE 7

SAE TYPE II, TYPE III and TYPE IV DE/ANTI-ICING FLUID APPLICATION PROCEDURES

Guidelines for the application of SAE Type II, III and IV fluid mixtures (minimum concentrations in % by volume) as a function of outside air temperature (OAT)

Outside Air Temperature (OAT) ¹	One-Step Procedure De/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing ²
-3°C (27°F) and above	50/50 Heated ³ Type II/III/IV	Heated water or a heated mix of Type I, II, III or IV with water	50/50 Type II/III/IV
-14°C (7°F) and above	75/25 Heated ³ Type II/III/IV	Heated suitable mix of Type I, Type II/III/IV and water with FP not more than 3°C (5°F) above actual OAT	75/25 Type II/III/IV
-25°C (-13°F) and above	100/0 Heated ³ Type II/III/IV	Heated suitable mix of Type I, Type II/III/IV and water with FP not more than 3°C (5°F) above actual OAT	100/0 Type II/III/IV
Below -25°C (-13°F)	Type II/III/IV fluid may be used below -25°C (-13°F) provided that the OAT is at or above the LOU ^T . Consider the use of Type I when Type II/III/IV fluid cannot be used (see Table 6).		

- 1 Fluids must not be used at temperatures below their lowest operational use temperature (LOU^T).
- 2 To be applied before first step fluid freezes, typically within 3 minutes. (This time may be higher than 3 minutes in some conditions, but potentially lower in heavy precipitation, colder temperatures, or for critical surfaces constructed of composite materials. If necessary, the second step shall be applied area by area.)
- 3 Clean aircraft may be anti-iced with unheated fluid.

NOTES

- For heated fluids, a fluid temperature not less than 60°C (140°F) at the nozzle is desirable. When the first step is performed using a fluid/water mix with a freezing point above OAT, the temperature at the nozzle shall be at least 60°C and at least 1 litre/m² (2 gal./100 sq. ft.) shall be applied to the surfaces to be de-iced.
- Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
- The lowest operational use temperature (LOU^T) 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 its freezing point buffer of 7°C (13°F).

CAUTIONS

- **Wing skin temperatures may differ and in some cases may be lower than outside air temperatures; a stronger mix (more glycol) may be needed under these conditions.**
- **Whenever frost or ice occurs on the lower surface of the wing in the area of the fuel tank, indicating a cold soaked wing, the 50/50 dilutions of Type II, III or IV shall not be used for the anti-icing step because fluid freezing may occur.**
- **An insufficient amount of anti-icing fluid may cause a substantial loss of holdover time. This is particularly true when using a Type I fluid mixture for the first step in a two-step procedure.**

TABLE 8
VISIBILITY IN SNOW VS. SNOWFALL INTENSITY¹

Lighting	Temperature Range		Visibility in Snow in Statute Miles (Metres)			
	°C	°F	Heavy	Moderate	Light	Very Light
Darkness	-1 and above	30 and above	≤1 (≤1600)	>1 to 2½ (>1600 to 4000)	>2½ to 4 (>4000 to 6400)	>4 (>6400)
	Below -1	Below 30	≤¾ (≤1200)	>¾ to 1½ (>1200 to 2400)	>1½ to 3 (>2400 to 4800)	>3 (>4800)
Daylight	-1 and above	30 and above	≤½ (≤800)	>½ to 1½ (>800 to 2400)	>1½ to 3 (>2400 to 4800)	>3 (>4800)
	Below -1	Below 30	≤¾ (≤600)	>¾ to 7/8 (>600 to 1400)	>7/8 to 2 (>1400 to 3200)	>2 (>3200)

¹ Based on: *Relationship between Visibility and Snowfall Intensity* (TP 14151E), Transportation Development Centre, Transport Canada, November 2003; and *Theoretical Considerations in the Estimation of Snowfall Rate Using Visibility* (TP 12893E), Transportation Development Centre, Transport Canada, November 1998.

HOW TO READ AND USE THE TABLE

The METAR/SPECI reported visibility or flight crew observed visibility will be used with this visibility table to establish snowfall intensity for Type I, II, III and IV holdover time guidelines, during snow, snow grain, or snow pellet precipitation conditions.

This visibility table will also be used when snow, snow grains or snow pellets are accompanied by blowing or drifting snow in the METAR/SPECI.

RVR values should not be used with this chart.

Example: *CYVO 160200Z 15011G17KT 1SM -SN DRSN OVC009 M06/M08 A2948*

In the above METAR the snowfall intensity is reported as light. However, based upon the Transport Canada “visibility in snow vs. snowfall intensity chart”, with a visibility of 1 statute mile, in darkness and a temperature of -6°C the snowfall intensity is classified as moderate. The snowfall intensity of moderate - not the METAR reported intensity of light - will be used to determine which holdover time guideline value is appropriate for the fluid in use.

TABLE 9
LOWEST ON-WING VISCOSITY VALUES FOR DE/ANTI-ICING FLUIDS

SIGNIFICANCE OF THIS TABLE: The viscosity values in this table are those of the fluids provided by the 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 value of a fluid sample taken from the wing surface is not lower than that listed.

Table 9-1: Type II De/Anti-Icing Fluids			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY ¹ (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 METHOD
ABAX Ecowing 26	100/0	4 900 (h)	4 600 (a)
	75/25	2 200 (a)	2 200 (a)
	50/50	50 (a)	50 (a)
Aviation Shaanxi Hi-Tech Cleanwing II	100/0	4 650 (e)	4 500 (a)
	75/25	9 450 (e)	10 000 (a)
	50/50	10 150 (e)	10 200 (a)
Clariant Safewing MP II FLIGHT	100/0	3 340 (a)	3 340 (a)
	75/25	12 900 (c)	12 900 (c)
	50/50	11 500 (a)	11 500 (a)
Clariant Safewing MP II FLIGHT PLUS	100/0	3,650 (n)	3 100 (a)
	75/25	12,400 (n)	10 450 (a)
	50/50	7,800 (n)	7 050 (a)
Clariant Safewing MP II 1951	100/0	2 500 (g)	2 750 (a)
	75/25	2 900 (g)	3 000 (a)
	50/50	50 (g)	50 (a)
Cryotech Polar Guard II	100/0	4 400 (f)	4 050 (a)
	75/25	11 600 (f)	9 750 (a)
	50/50	80 (a)	80 (a)
Kilfrost ABC-3	100/0	2 500 (e)	2 500 (a)
	75/25	2 000 (e)	2 000 (a)
	50/50	400 (e)	400 (a)
Kilfrost ABC-K Plus	100/0	2 850 (e)	2 640 (a)
	75/25	12 650 (e)	12 650 (c)
	50/50	4 200 (e)	5 260 (a)
LNT Solutions P250	100/0	2 400 (dd)	2 150 (a)
	75/25	16 200 (dd)	15 200 (a)
	50/50	8 150 (dd)	8 100 (a)
Newave Aerochemical FCY-2	100/0	7 000 (e)	8 920 (a)
	75/25	18 550 (e)	18 550 (e)
	50/50	6 750 (e)	7 030 (a)

See notes on page 52

Table 9-2: Type III De/Anti-Icing Fluids			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY ¹ (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 METHOD
Clariant Safewing MP III 2031 ECO	100/0	120 (m)	Not Applicable
	75/25	55 (m)	Not Applicable
	50/50	10 (m)	Not Applicable

See notes on page 52

**TABLE 9 (cont.)
LOWEST ON-WING VISCOSITY VALUES FOR DE/ANTI-ICING FLUIDS**

Table 9-3: Type IV De/Anti-Icing Fluids			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY ¹ (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 METHOD
ABAX AD-480	100/0	15 200 (h)	12 800 (d)
	75/25	16 000 (h)	12 400 (d)
	50/50	4 000 (h)	3 800 (a)
ABAX Ecowing AD-49	100/0	12 150 (i)	11 000 (a)
	75/25	30 700 (i)	32 350 (c)
	50/50	19 450 (i)	21 150 (c)
Clariant Max Flight 04	100/0	5 540 (b)	5 540 (a)
	75/25	Dilution Not Applicable	Dilution Not Applicable
	50/50	Dilution Not Applicable	Dilution Not Applicable
Clariant Max Flight Sneg	100/0	8 700 (o)	8 050 (a)
	75/25	20 200 (p)	21 800 (c)
	50/50	13 600(p)	15 000 (c)
Clariant Safewing MP IV LAUNCH	100/0	7 550 (a)	7 550 (a)
	75/25	18 000 (a)	18 000 (a)
	50/50	17 800 (a)	17 800 (a)
Clariant Safewing MP IV LAUNCH PLUS	100/0	8,700 (o)	8,450 (a)
	75/25	18,800 (p)	17,200 (c)
	50/50	9,700 (o)	12,150 (a)
Cryotech Polar Guard	100/0	32 100 (k)	36 300 (c)
	75/25	24 200 (k)	27 800 (c)
	50/50	6 200 (k)	7 500 (a)
Cryotech Polar Guard Advance	100/0	4 400 (f)	4 050 (a)
	75/25	11 600 (f)	9 750 (a)
	50/50	80 (a)	80 (a)
Dow UCAR™ Endurance EG106	100/0	24 850 (j)	2 230 (a)
	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 (h)	12 800 (d)
	75/25	16 000 (h)	12 400 (d)
	50/50	4 000 (h)	3 800 (a)
Dow UCAR™ FlightGuard AD-49	100/0	12 150 (i)	11 000 (a)
	75/25	30 700 (i)	32 350 (c)
	50/50	19 450 (i)	21 150 (c)
Kilfrost ABC-S	100/0	17 000 (e)	17 000 (c)
	75/25	12 000 (e)	12 000 (c)
	50/50	2 000 (e)	2 000 (a)
Kilfrost ABC-S Plus	100/0	17 900 (e)	17 900 (c)
	75/25	18 300 (e)	18 300 (c)
	50/50	7 500 (e)	7 500 (a)
See next page for additional Type IV fluids and notes			

**TABLE 9 (cont.)
LOWEST ON-WING VISCOSITY VALUES FOR DE/ANTI-ICING FLUIDS**

Table 9-3: Type IV De/Anti-Icing Fluids (cont'd)			
FLUID NAME	FLUID DILUTION	LOWEST ON-WING VISCOSITY ¹ (mPa.s)	
		MANUFACTURER METHOD	AIR 9968 METHOD
LNT Solutions E450	100/0	45 300 (l)	Not Available ²
	75/25	Dilution Not Applicable	Dilution Not Applicable
	50/50	Dilution Not Applicable	Dilution Not Applicable
Newave Aerochemical FCY 9311	100/0	14 100 (c)	14 100 (c)
	75/25	Dilution Not Applicable	Dilution Not Applicable
	50/50	Dilution Not Applicable	Dilution Not Applicable
See notes below			

NOTES

- 1 The Aerospace Information Report (AIR) 9968 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. Viscosity measurement methods are indicated as letters (in parentheses) beside each viscosity value. Details of each measurement method are shown in the table below. The exact measurement method (spindle, container, fluid volume, temperature, speed, duration) must be used to compare the viscosity of a sample to a viscosity given in this table.
- 2 Measurements using the AIR 9968 method do not provide stable, reliable results. Use the manufacturer method to evaluate the viscosity of this fluid.

Method	Brookfield Spindle	Container	Fluid Volume	Temp.	Speed	Duration
a	LV1 (with guard leg)	600 mL low form (Griffin) beaker	575 mL*	20°C	0.3 rpm	10 minutes 0 seconds
b	LV1 (with guard leg)	600 mL low form (Griffin) beaker	575 mL*	20°C	0.3 rpm	33 minutes 20 seconds
c	LV2-disc (with guard leg)	600 mL low form (Griffin) beaker	425 mL*	20°C	0.3 rpm	10 minutes 0 seconds
d	LV2-disc (with guard leg)	250 mL tall form (Berzelius) beaker	200 mL*	20°C	0.3 rpm	10 minutes 0 seconds
dd	LV2-disc (with guard leg)	200 mL tall form (Berzelius) beaker	155 mL*	20°C	0.3 rpm	10 minutes 0 seconds
e	LV2-disc (with guard leg)	150 mL tall form (Berzelius) beaker	135 mL*	20°C	0.3 rpm	10 minutes 0 seconds
f	SC4-34/13R	small sample adapter	10 mL	20°C	0.3 rpm	10 minutes 0 seconds
g	SC4-34/13R	small sample adapter	10 mL	20°C	0.3 rpm	15 minutes 0 seconds
h	SC4-34/13R	small sample adapter	10 mL	20°C	0.3 rpm	30 minutes 0 seconds
i	SC4-31/13R	small sample adapter	10 mL	20°C	0.3 rpm	10 minutes 0 seconds
j	SC4-31/13R	small sample adapter	10 mL	0°C	0.3 rpm	10 minutes 0 seconds
k	SC4-31/13R	small sample adapter	9 mL	20°C	0.3 rpm	10 minutes 0 seconds
l	SC4-31/13R	small sample adapter	9 mL	0°C	0.3 rpm	10 minutes 0 seconds
m	LV0	UL adapter	16 mL	20°C	0.3 rpm	10 minutes 0 seconds
n	LV1	big sample adapter	50 mL	20°C	0.3 rpm	10 minutes 0 seconds
o	LV1	big sample adapter	55 mL	20°C	0.3 rpm	10 minutes 0 seconds
p	LV2-disc	big sample adapter	60 mL	20°C	0.3 rpm	10 minutes 0 seconds

*If necessary, adjust fluid volume to ensure fluid is level with notch on the spindle shaft

TABLE 10
LOWEST OPERATIONAL USE TEMPERATURES¹ OF DE/ANTI-ICING FLUIDS (2014-2015)

Table 10-1: Type I De/Anti-Icing Fluids		
FLUID NAME	LOWEST OPERATIONAL USE TEMPERATURES¹ (°C) WITH CORRESPONDING FLUID DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	
	LOW SPEED AERODYNAMIC TEST²	HIGH SPEED AERODYNAMIC TEST²
ABAX DE-950	-26 for 71/29 dilution	-31 for 71/29 dilution
ABAX DE-950 Colorless	Not tested ⁴	-24 for 60/40 dilution
AllClear Systems LLC Lift-Off P-88	-24.5 for 70/30 dilution	-29.5 for 70/30 dilution
AllClear Systems LLC Lift-Off E-188	-40 for 70/30 dilution	-41.5 for 70/30 dilution
Arcton Arctica DG ready-to-use	-26 as supplied	-26 as supplied
Arcton Arctica DG 91 Concentrate	-25 for 75/25 dilution	-25 for 75/25 dilution
Aviation Shaanxi Hi-Tech Cleanwing I	Not tested ⁴	-39.5 for 75/25 dilution
Aviation Xi'an Hi-Tech KHF-1	Not available ³	-38.5 for 75/25 dilution
Baltic Ground Services DEFROSOL ADF	-25 for 65/35 dilution	-30 for 65/35 dilution
Beijing Phoenix Air Traffic CBSX-1	Not available ³	Not available ³
Beijing Wangye Aviation Chemical KLA-1	Not available ³	-30.5 for 60/40 dilution
Beijing Yadilite Aviation Chemical Product Co. Ltd YD-101 Type I	Not tested ⁴	-30 for 60/40 dilution
CHEMCO CHEMR EG I	-30 for 75/25 dilution	-40 for 75/25 dilution
CHEMCO CHEMR REG I	Not available ³	-40.5 for 75/25 dilution
Clariant EcoFlo Concentrate	Not tested ⁴	-30.5 for 65/35 dilution
Clariant EcoFlo 2 Concentrate	Not tested ⁴	-29 for 65/35 dilution
Clariant Octaflo EF Concentrate	-25 for 65/35 dilution	-33 for 65/35 dilution
Clariant Octaflo EF-80	-25 for 70/30 dilution	-33 for 70/30 dilution
Clariant Octaflo EG Concentrate	-40.5 for 70/30 dilution	-44 for 70/30 dilution
Clariant Octaflo Lyod	-40 for 70/30 dilution	-45.5 for 70/30 dilution
Clariant Safewing EG I 1996	-35.5 for 75/25 dilution	-43 for 75/25 dilution
Clariant Safewing EG I 1996 (88)	-39.5 for 70/30 dilution	-41.5 for 70/30 dilution
Clariant Safewing MP I 1938 ECO	-25.5 for 65/35 dilution	-32 for 65/35 dilution
Clariant Safewing MP I 1938 ECO (80)	-25 for 71/29 dilution	-32.5 for 71/29 dilution
Clariant Safewing MP I 1938 ECO (80) Premix 55% i.g. ready-to-use	Not tested ⁴	-19 as supplied
Clariant Safewing MP I ECO PLUS (80)	-25 for 71/29 dilution	-33 for 71/29 dilution
Cryotech Polar Plus [®] Concentrate	-27 for 63/37 dilution	-32 for 63/37 dilution
Cryotech Polar Plus [®] LT	-27 for 63/37 dilution	-33 for 63/37 dilution
Cryotech Polar Plus [®] (80)	-24.5 for 70/30 dilution	-32.5 for 70/30 dilution
Deicing Solutions LLC Safetemp [®] ES Plus	-25.5 for 65/35 dilution	-29 for 65/35 dilution
Dow UCAR [™] Aircraft Deicing Fluid Concentrate	-36.5 for 75/25 dilution	-45 for 75/25 dilution
Dow UCAR [™] ADF XL54	-33 as supplied	-33 as supplied
Dow UCAR [™] PG Aircraft Deicing Fluid Concentrate	-25 for 65/35 dilution	-32 for 65/35 dilution

See next page for additional Type I fluids and Table 10-1 notes and cautions

TABLE 10 (cont.)
 LOWEST OPERATIONAL USE TEMPERATURES¹ OF DE/ANTI-ICING FLUIDS (2014-2015)

Table 10-1: Type I De/Anti-Icing Fluids (cont.)		
FLUID NAME	LOWEST OPERATIONAL USE TEMPERATURES ¹ (°C) WITH CORRESPONDING FLUID DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	
	LOW SPEED AERODYNAMIC TEST ²	HIGH SPEED AERODYNAMIC TEST ²
Dow UCAR™ PG ADF Dilute 55/45	-24 as supplied	-25 as supplied
Heilongjiang Hangjie Aero-chemical (formerly Harbin Aeroclean Aviation) HJF-1	Not tested ⁴	-42 for 65/35 dilution
HOC SafeTemp® ES Plus	-25.5 for 65/35 dilution	-29 for 65/35 dilution
Hokkaido Fever Snow AG	-21.5 as supplied	-23 as supplied
Inland Technologies Duragly-E Concentrate	-26 for 60/40 dilution	-26 for 60/40 dilution
Inland Technologies Duragly-P Concentrate	-25 for 60/40 dilution	-25 for 60/40 dilution
Kilfrost DF Plus	-25.5 for 69/31 dilution	-32 for 69/31 dilution
Kilfrost DF Plus (80)	-26 for 69/31 dilution	-31.5 for 69/31 dilution
Kilfrost DF Plus (88)	-26.5 for 63/37 dilution	-32 for 63/37 dilution
Kilfrost DF ^{sustain™}	-34 for 68/32 dilution	-41 for 68/32 dilution
LNT Solutions E188	-30.5 for 70/30 dilution	-41 for 70/30 dilution
LNT Solutions P180	-26 for 69/31 dilution	-32 for 69/31 dilution
LNT Solutions P188	-24.5 for 70/30 dilution	-31.5 for 70/30 dilution
Newave FCY-1A	-40 for 75/25 dilution	-40 for 75/25 dilution
Newave FCY-1Bio ⁺	Not tested ⁴	-40.5 for 75/25 dilution
Shaanxi Cleanway Cleansurface I	-32.5 for 75/25 dilution ⁵	-40.5 for 75/25 dilution
Shaanxi Cleanway Cleansurface I-BIO	Not tested ⁴	-37 for 75/25 dilution

NOTES

- 1 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 its freezing point buffer of 10°C (18°F).
 The values in this table were determined using pre-production fluid samples when available. In some cases, the fluid manufacturer requested the publication of a more conservative value than the pre-production test value.
- 2 If uncertain whether the aircraft to be treated conforms to the low speed or the high speed aerodynamic test, consult the aircraft manufacturer. The aerodynamic test is defined in SAE AS 5900 (latest version).
- 3 Manufacturer had not provided LOUT information at the time of publication.
- 4 Manufacturer has indicated fluid was not tested.
- 5 Fluid was not retested for low speed aerodynamics. This data will be removed four years after the expiry of the last low speed aerodynamics test.

CAUTIONS

- LOUT data provided in this table is based strictly on the manufacturer's data, the end user is responsible for verifying the validity of this data.
- Fluids supplied in concentrated form must not be used in that form and must be diluted.
- For the fluids in the table that are intended to be diluted, the LOUT is derived from a dilution that provides the lowest operational use temperature. For other dilutions, determine the freezing point of the fluid, and add a 10°C freezing point buffer, as a dilution will usually yield a higher and more restrictive operational use temperature. Consult the fluid manufacturer or fluid documentation for further clarification and guidance on establishing the appropriate operational use temperature of a diluted fluid.

TABLE 10 (cont.)
 LOWEST OPERATIONAL USE TEMPERATURES¹ OF DE/ANTI-ICING FLUIDS (2014-2015)

Table 10-2: Type II De/Anti-Icing Fluids		
FLUID NAME	DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	LOWEST OPERATIONAL USE TEMPERATURE ¹ (°C)
		HIGH SPEED AERODYNAMIC TEST ²
ABAX Ecowing 26	100/0	-25
	75/25	-14
	50/50	-3
Aviation Shaanxi Hi-Tech Cleanwing II	100/0	-29
	75/25	-14
	50/50	-3
Clariant Safewing MP II 1951	100/0	-28
	75/25	-14
	50/50	-3
Clariant Safewing MP II FLIGHT	100/0	-29
	75/25	-14
	50/50	-3
Clariant Safewing MP II FLIGHT PLUS	100/0	-29
	75/25	-14
	50/50	-3
Cryotech Polar Guard II	100/0	-30.5
	75/25	-14
	50/50	-3
Kilfrost ABC-3	100/0	-27
	75/25	-14
	50/50	-3
Kilfrost ABC-K Plus	100/0	-29
	75/25	-14
	50/50	-3
LNT Solutions P250	100/0	Not available ³
	75/25	Not available ³
	50/50	Not available ³
Newave Aerochemical FCY-2	100/0	-28
	75/25	-14
	50/50	-3

See page 57 for notes and caution

TABLE 10 (cont.)
LOWEST OPERATIONAL USE TEMPERATURES¹ OF DE/ANTI-ICING FLUIDS (2014-2015)

Table 10-3: Type III De/Anti-Icing Fluids			
FLUID NAME	DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	LOWEST OPERATIONAL USE TEMPERATURE¹ (°C)	
		LOW SPEED AERODYNAMIC TEST²	HIGH SPEED AERODYNAMIC TEST²
Clariant Safewing MP III 2031 ECO	100/0	-16.5	-29
	75/25	-9	-10
	50/50	-3	-3
See next page for notes and caution			

Table 10-4: Type IV De/Anti-Icing Fluids		
FLUID NAME	DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	LOWEST OPERATIONAL USE TEMPERATURE¹ (°C)
		HIGH SPEED AERODYNAMIC TEST²
ABAX AD-480	100/0	-26
	75/25	-14
	50/50	-3
ABAX Ecowing AD-49	100/0	-26
	75/25	-14
	50/50	-3
Clariant Max Flight 04	100/0	-23.5
	75/25	Dilution Not Applicable
	50/50	Dilution Not Applicable
Clariant Max Flight Sneg	100/0	-29
	75/25	-14
	50/50	-3
Clariant Safewing MP IV LAUNCH	100/0	-28.5
	75/25	-14
	50/50	-3
Clariant Safewing MP IV LAUNCH PLUS	100/0	-29
	75/25	-14
	50/50	-3
Cryotech Polar Guard	100/0	-23.5
	75/25	-5.5
	50/50	-3
Cryotech Polar Guard Advance	100/0	-30.5
	75/25	-14
	50/50	-3
Dow UCAR™ Endurance EG106 De/Anti-Icing Fluid	100/0	-27
	75/25	Dilution Not Applicable
	50/50	Dilution Not Applicable
See next page for additional Type IV fluids, notes and caution		

TABLE 10 (cont.)
LOWEST OPERATIONAL USE TEMPERATURES¹ OF DE/ANTI-ICING FLUIDS (2014-2015)

Table 10-4: Type IV De/Anti-Icing Fluids (cont.)		
FLUID NAME	DILUTION, NEAT FLUID/WATER (VOLUME %/VOLUME %)	LOWEST OPERATIONAL USE TEMPERATURES ¹ (°C)
		HIGH SPEED AERODYNAMIC TEST ²
Dow UCAR™ FlightGuard AD-480	100/0	-26
	75/25	-14
	50/50	-3
Dow UCAR™ FlightGuard AD-49	100/0	-26
	75/25	-14
	50/50	-3
Kilfrost ABC-S	100/0	-28
	75/25	-14
	50/50	-3
Kilfrost ABC-S Plus	100/0	-28
	75/25	-14
	50/50	-3
LNT Solutions E450	100/0	Not available ³
	75/25	Dilution Not Applicable
	50/50	Dilution Not Applicable
Newave Aerochemical FCY 9311	100/0	-29.5
	75/25	Dilution Not Applicable
	50/50	Dilution Not Applicable

NOTES

- 1 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 its freezing point buffer of 7°C (13°F).

For the 75/25 and 50/50 dilutions, the holdover time table temperature band limits are posted in the cases where the manufacturer’s LOUT is lower than those limits.

The values in this table were determined using pre-production fluid samples when available. In some cases, the fluid manufacturer requested the publication of a more conservative value than the pre-production test value.
- 2 If uncertain whether the aircraft to be treated conforms to the low speed or the high speed aerodynamic test, consult the aircraft manufacturer. The aerodynamic test is defined in SAE AS 5900 (latest version).
- 3 Manufacturer had not provided LOUT information at the time of publication.

CAUTION

- LOUT data provided in this table is based strictly on the manufacturer’s data, the end user is responsible for verifying the validity of this data.

ICE PELLET AND SMALL HAIL ALLOWANCE TIMES FOR WINTER 2014-2015

Comprehensive ice pellet research was conducted jointly by the research teams of the FAA and Transport Canada. This research consisted of extensive climatic chamber, wind tunnel, and live aircraft testing with ice pellets (light or moderate) and light ice pellets mixed with other forms of precipitation.

Results of this research provide the basis for allowance times for operations in ice pellets (light or moderate) and operations in light ice pellets mixed with other forms of precipitation. Allowance times for small hail are also provided, as it has been determined small hail is meteorologically equivalent to moderate ice pellets.

In 2014-15, allowance times were published for undiluted (100/0) Type III fluid applied unheated. Further testing is required to expand allowance times in other conditions, such as temperatures below -10°C .

Additionally, Type IV anti-icing fluid with ice pellets embedded was evaluated for its aging qualities over periods of time beyond the allowance times, when the active precipitation time was limited to the allowance times.

Operational Guidelines

- 1) Tests have shown that ice pellets generally remain in a frozen state embedded in Type III or Type IV anti-icing fluid and are not dissolved by the fluid in the same manner as other forms of precipitation. Using current guidelines for determining anti-icing fluid failure, the presence of a contaminant not dissolved by the fluid (i.e. remaining embedded) is an indication that the fluid has failed. These embedded ice pellets are generally not readily detectable by the human eye during pre-takeoff contamination inspection procedures.
- 2) The research data have also shown that after proper deicing and anti-icing, the accumulation of light ice pellets, moderate ice pellets, and light ice pellets mixed with other forms of precipitation in Type III or Type IV fluid will not prevent the fluid from flowing off of the aerodynamic surfaces during takeoff.
- 3) The allowance times were developed based on this aerodynamic testing and are contained in Table 11 and Table 12.
- 4) Research has also shown that Type IV propylene glycol (PG) and Type IV ethylene glycol (EG) fluids behave differently under certain temperature and ice pellet precipitation conditions. Currently all Type IV fluids are PG based with the exception of Dow Chemical EG106 and LNT Solutions E450 which are EG based. Higher aircraft rotation speeds are required to effectively remove Type IV PG fluid contaminated with light or moderate ice pellets at temperatures below -10°C . Therefore, there are no allowance times associated with the use of Type IV PG fluids on aircraft with rotation speeds of less than 115 knots in conditions of light or moderate ice pellets at temperatures below -10°C .
- 5) Research has indicated that Type IV propylene glycol (PG) fluids are removed less effectively when contaminated with moderate ice pellets at temperatures below -16°C ; operations in these conditions are not recommended. Therefore, there are no allowance times associated with the use of PG fluids in conditions of moderate ice pellets at temperatures below -16°C , irrespective of aircraft rotation speed.
- 6) Furthermore, recent research with newer generation type airfoils has shown that the allowance times are shorter when using Type IV PG fluids under certain conditions. Since it is challenging to determine exactly which aircraft may be affected, the allowance time when using Type IV PG fluids at temperatures of -5°C and above is limited to 15 minutes in moderate ice pellets.

- 7) The ice pellet allowances are contingent on the operator's approved ground icing program being updated to incorporate the ice pellet information contained herein, including the following conditions and restrictions that must be satisfied:
- a) The aircraft critical surfaces must be properly deiced before the application of Type III or Type IV anti-icing fluid;
 - b) The allowance time is valid only if the aircraft is anti-iced with undiluted Type III or Type IV fluid;
 - c) The Type III allowance times are only applicable for un-heated anti-icing fluid applications;
 - d) These allowance times are applicable from the start of the Type III or Type IV anti-icing fluid application;
 - e) The allowance time is limited to aircraft with a rotation speed of 100 knots or greater (subject to 4) above);
 - f) If the takeoff is not accomplished within the applicable allowance time in Table 11 or 12, the aircraft must be completely deiced, and if precipitation is still present, anti-iced again prior to a subsequent takeoff;
 - g) The allowance time cannot be extended by an inspection of the aircraft critical surfaces from either inside or outside the aircraft;
 - h) If the temperature decreases below the temperature on which the allowance time was based, where 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;
 - i) 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;
 - j) If the precipitation condition stops at, or before, the time limit of the applicable allowance time in Table 11 or 12 and does not restart, the aircraft may take off up to 90 minutes after the start of the application of the Type III or Type IV anti-icing fluid. However, the OAT must remain constant or increase during the 90-minute period under the following conditions:
 - light ice pellets mixed with light or moderate freezing drizzle;
 - light ice pellets mixed with light freezing rain;
 - light ice pellets mixed with light rain; and
 - light ice pellets mixed with moderate rain.
- 8) Examples:
- a) Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0°C, light ice pellets fall until 10:20 and stop and do not restart. The allowance time stops at 10:50; however, provided that no precipitation restarts after the allowance time of 10:50; the aircraft may take off without any further action until 11:30.
 - b) Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0°C, light ice pellets mixed with freezing drizzle falls until 10:10, 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 no precipitation restarts after the end of the allowance time at 10:25, the aircraft may take off without any further action until 11:30.

- c) Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0°C, light ice pellets mixed with light freezing rain falls until 10:10, 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 no precipitation restarts after the end of the allowance time at 10:25, the aircraft may take off without any further action until 11:30.
- d) On the other hand, if Type IV anti-icing fluid is applied with a start of application time of 10:00, OAT is 0°C, light ice pellets mixed with freezing drizzle falls until 10:10, stops and restarts at 10:30, with the allowance time stopping at 10:25, the aircraft may not take off, no matter how short the time or type of precipitation after 10:25, without being deiced and anti-iced if precipitation is present.

TABLE 11

SAE TYPE III ICE PELLET AND SMALL HAIL ALLOWANCE TIMES

This table is for use with SAE Type III undiluted (100/0) fluids applied unheated only

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

Precipitation Type	Outside Air Temperature		
	-5°C and above	Below -5 to -10°C	Below -10°C ¹
Light Ice Pellets	10 minutes	10 minutes	Caution: No allowance times currently exist
Moderate Ice Pellets or Small Hail	5 minutes	5 minutes	
Light Ice Pellets Mixed with Light or Moderate Freezing Drizzle	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Freezing Rain	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Rain	7 minutes ²		
Light Ice Pellets Mixed with Moderate Rain			
Light Ice Pellets Mixed with Light Snow	10 minutes	10 minutes	
Light Ice Pellets Mixed with Moderate Snow	10 minutes	10 minutes	

NOTES

- 1 Ensure that the lowest operational use temperature (LOUT) is respected.
- 2 No allowance times exist in this condition for temperatures below 0°C; consider use of light ice pellets mixed with light freezing rain.

CAUTIONS

- Fluids used during ground de/anti-icing do not provide in-flight icing protection.

TABLE 12

SAE TYPE IV ICE PELLET AND SMALL HAIL ALLOWANCE TIMES

This table is for use with SAE Type IV undiluted (100/0) fluids only.

All Type IV fluids are propylene glycol based with the exception of Dow EG106 and LNT Solutions E450 which are ethylene glycol based.

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

Precipitation Type	Outside Air Temperature		
	-5°C and above	Below -5 to -10°C	Below -10°C ¹
Light Ice Pellets	50 minutes	30 minutes	30 minutes ²
Moderate Ice Pellets or Small Hail	25 minutes ³	10 minutes	10 minutes ^{2,4}
Light Ice Pellets Mixed with Light or Moderate Freezing Drizzle	25 minutes	10 minutes	Caution: No allowance times currently exist
Light Ice Pellets Mixed with Light Freezing Rain	25 minutes	10 minutes	
Light Ice Pellets Mixed with Light Rain	25 minutes ⁵		
Light Ice Pellets Mixed with Moderate Rain	25 minutes ⁶		
Light Ice Pellets Mixed with Light Snow	25 minutes	15 minutes	
Light Ice Pellets Mixed with Moderate Snow	10 minutes	7 minutes	

NOTES

- 1 Ensure that the lowest operational use temperature (LOUT) is respected.
- 2 No allowance times exist for propylene glycol (PG) fluids, when used on aircraft with rotation speeds less than 115 knots. (For these aircraft, if the fluid type is not known, assume zero allowance time).
- 3 Allowance time is 15 minutes for propylene glycol (PG) fluids or when the fluid type is unknown.
- 4 No allowance times exist for propylene glycol (PG) fluids in this condition for temperatures below -16°C.
- 5 No allowance times exist in this condition for temperatures below 0°C; consider use of light ice pellets mixed with light freezing rain.
- 6 No allowance times exist in this condition for temperatures below 0°C.

CAUTIONS

- Fluids used during ground de/anti-icing do not provide in-flight icing protection.