

Transport Canada Holdover Time (HOT) Guidelines Winter 2013-2014

Original Issue, August 2013

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>

OBSOLETE

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

- Changes have been made to the Clariant Safewing MP II FLIGHT PLUS 100/0 and 75/25 snow holdover times as the result of supplemental testing carried out in the winter of 2012-2013.
- A fluid-specific HOT guideline has been created for the new Type II fluid Cryotech Polar Guard II.
- LNT Solutions P250 has been removed from the guidelines at the request of the manufacturer. This fluid was never commercialized.
- Some Type II fluid-specific HOT tables have been upgraded to include three columns of snow holdover times. The three columns provide holdover times for three snowfall intensities: very light, light and moderate. Snowfall intensity must be determined using Table 8 "Visibility In Snow vs. Snowfall Intensity". The affected Type II HOT tables are: ABAX Ecowing 26, Clariant Safewing MP II FLIGHT and Cryotech Polar Guard II.
- The Type II generic HOT guidelines are unchanged. No changes have been made to the table values or table format; the table retains a single column for snow.

Type III Fluid

- The Type III HOT guidelines are unchanged.

Type IV Fluid

- Clariant Max Flight 04 75/25 and 50/50 dilutions have been removed from the guidelines at the request of the manufacturer. As of the publication of this document, no holdover times exist for dilutions of this fluid.
- A fluid-specific HOT guideline has been created for the new Type IV fluid Clariant Safewing MP IV LAUNCH PLUS.
- Kilfrost ABC-4^{sustain} has been removed from the guidelines at the request of the manufacturer. This fluid was never commercialized.
- Some Type IV fluid-specific HOT tables have been upgraded to include three columns of snow holdover times. The three columns provide holdover times for three snowfall intensities: very light, light and moderate. Snowfall intensity must be determined using Table 8 "Visibility In Snow vs. Snowfall Intensity". The affected Type IV HOT tables are: ABAX Ecowing AD-49, Kilfrost ABC-S Plus, Clariant Max Flight 04, Clariant Safewing MP IV LAUNCH, Clariant Safewing MP IV LAUNCH PLUS, Cryotech Polar Guard Advance, Dow UCAR™ Endurance EG106 and Dow UCAR™ FlightGuard AD-49.
- Nine increases have been made to the Type IV generic HOT guidelines as a result of the removal of Kilfrost ABC-4^{sustain} and Clariant Max Flight 04 dilutions. No changes have been made to the table format; the table retains a single column for snow.

Ice Crystals

- Recent testing has shown that freezing fog holdover times can be used in ice crystal conditions. As a result, the freezing fog columns in all Type I, Type II, Type III and Type IV fluid HOT tables have been modified to include ice crystals. Furthermore, TP 14052 has been modified to include guidance for

operating without fluids in certain ice crystal conditions (cold temperatures when it can be determined the ice crystals are not adhering to the wing).

Guidance on Use of Visibility Table and Determination of Snowfall Intensity

- New guidance has been added to the visibility table and TP 14052 to clarify proper use of the visibility table, including: operational examples with METARs, improper use of RVR to determine visibility, and obscuration of visibility by freezing fog.

Ice Pellet Allowance Times

- The ice pellet allowance times are unchanged.

OBSOLETE

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 Allowance Times.

Replace Sub-Paragraph 11.1.4.1 a) "Estimating the Precipitation Rate" with the following: (modified 2013-14)

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:

- RVR transmissometers were never intended to measure visibility with respect to snowfall intensity for use with holdover time guidelines.
- 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.
- 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, 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 yet been identified for ice pellet conditions. Instead, an allowance time based upon research has been developed for operations during ice pellet 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: (added 2013-14)

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: (added 2013-14)

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: (modified 2013-14)**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 (i.e. SKC, high FEW or high SCT), low wind (i.e. less than 10 knots), and low light (i.e. 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.

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 "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": (added 2013-14)*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 2013-2014

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	ABAX Type II Fluid Holdover Guidelines Ecowing 26
Table 2-AS-Cleanwing II	Aviation Shaanxi Hi-Tech Type II Fluid Holdover Guidelines Cleanwing II
Table 2-C-FLIGHT	Clariant Type II Fluid Holdover Guidelines Safewing MP II FLIGHT
Table 2-C-FLIGHT+	Clariant Type II Fluid Holdover Guidelines Safewing MP II FLIGHT PLUS
Table 2-CR-PG-II	Cryotech Type II Fluid Holdover Guidelines Polar Guard II
Table 2-K-ABC-2000	Kilfrost Type II Fluid Holdover Guidelines ABC-2000
Table 2-K-ABC-K+	Kilfrost Type II Fluid Holdover Guidelines ABC-K Plus
Table 2-N-FCY-2	Newave Aerochemical Type II Fluid Holdover Guidelines FCY-2
Table 3	SAE Type III Fluid Holdover Guidelines
Table 4-Generic	SAE Type IV Fluid Holdover Guidelines
Table 4-A-AD-480	ABAX Type IV Fluid Holdover Guidelines AD-480
Table 4-A-Ecowing AD-49	ABAX Type IV Fluid Holdover Guidelines Ecowing AD-49
Table 4-C-MF-04	Clariant Type IV Fluid Holdover Guidelines Max Flight 04 <i>(formerly Octagon Max Flight 04)</i>
Table 4-C-LAUNCH	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV LAUNCH
Table 4-C-LAUNCH+	Clariant Type IV Fluid Holdover Guidelines Safewing MP IV LAUNCH PLUS
Table 4-CR-PG	Cryotech Type IV Fluid Holdover Guidelines Polar Guard
Table 4-CR-PG-A	Cryotech Type IV Fluid Holdover Guidelines Polar Guard Advance
Table 4-D-E106	Dow Chemical Type IV Fluid Holdover Guidelines UCAR™ Endurance EG106
Table 4-D-AD-480	Dow Chemical Type IV Fluid Holdover Guidelines UCAR™ FlightGuard AD-480
Table 4-D-AD-49	Dow Chemical Type IV Fluid Holdover Guidelines UCAR™ FlightGuard AD-49
Table 4-K-ABC-S	Kilfrost Type IV Fluid Holdover Guidelines ABC-S
Table 4-K-ABC-S+	Kilfrost Type IV Fluid Holdover Guidelines ABC-S Plus
Table 4-L-ARCTIC Shield	Lyondell Type IV Fluid Holdover Guidelines ARCTIC Shield™
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	Ice Pellet Allowance Times

TABLE 0

ACTIVE FROST HOLDOVER GUIDELINES FOR WINTER 2013-2014

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

Outside Air Temperature		Approximate Holdover Times (hours:minutes)	Outside Air Temperature		Concentration Neat Fluid/Water (Volume %/ Volume %)	Approximate Holdover Times (hours:minutes)		
Degrees Celsius	Degrees Fahrenheit	Active Frost	Degrees Celsius	Degrees Fahrenheit		Active Frost		
		Type I ^{1,2}				Type II ^{2,3}	Type III ^{2,3}	Type IV ^{2,3}
-1 and above	30 and above	0:45 (0:35) ⁴	-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 LOUT	below -6 to LOUT	100/0	2:00	2:00	4:00			

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 (see Table 10).
- 3 These fluids may not be used below -25°C (-13°F) in active frost conditions.
- 4 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 SURFACES FOR WINTER 2013-2014¹

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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
			Very Light ³	Light ³	Moderate				
-3 and above	27 and above	11 – 17	18	11 – 18	6 – 11	9 – 13	4 – 6	2 – 5	
below -3 to -6	below 27 to 21	8 – 13	14	8 – 14	5 – 8	5 – 9	4 – 6	CAUTION: No holdover time guidelines exist	
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover time guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, 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 SURFACES FOR WINTER 2013-2014¹

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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
			Very Light ³	Light ³	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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover time guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, 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 GUIDELINES FOR WINTER 2013-2014¹

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 ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other 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 ⁷	0:10 – 0:20 ⁷		
		75/25	0:25 – 0:50	0:10 – 0:20	0:15 – 0:30 ⁷	0:08 – 0:15 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

ABAX TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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	
		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 ⁷	0:15 – 0:35 ⁷	CAUTION: No holdover time guidelines exist	
		75/25	0:35 – 1:15	0:55	0:40 – 0:55	0:25 – 0:40	0:20 – 0:50 ⁷	0:15 – 0:25 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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-CLEANWING II

**AVIATION SHAANXI HI-TECH TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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 ⁶
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	
-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 ⁷	0:20 – 0:25 ⁷		
		75/25	0:40 – 1:45	0:25 – 0:45	0:35 – 0:40 ⁷	0:20 – 0:25 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

CLARIANT TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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	CAUTION: No holdover time guidelines exist
		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 ⁷	0:25 – 0:45 ⁷		
		75/25	0:25 – 1:05	1:20	0:40 – 1:20	0:20 – 0:40	0:25 – 1:10 ⁷	0:20 – 0:35 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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+

CLARIANT TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
-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 ⁷	0:35 – 0:55 ⁷		
		75/25	0:30 – 1:45	0:55 – 1:40	0:25 – 1:10 ⁷	0:30 – 0:45 ⁷		
below -14 to LOU ^T	below 7 to LOU ^T	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 (LOU^T) is respected. Consider use of Type I when Type II fluid cannot be used.
- 3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

CRYOTECH TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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 ⁷	0:35 – 0:45 ⁷	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 ⁷	0:35 – 0:45 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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-2000

**KILFROST TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
ABC-2000**

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 ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
-3 and above	27 and above	100/0	1:30 – 3:05	0:30 – 1:00	0:55 – 1:35	0:40 – 0:50	0:15 – 1:10	CAUTION: No holdover time guidelines exist
		75/25	1:40 – 3:30	0:30 – 1:05	0:45 – 1:15	0:40 – 0:50	0:15 – 1:40	
		50/50	1:00 – 2:10	0:15 – 0:30	0:15 – 0:25	0:08 – 0:15		
below -3 to -14	below 27 to 7	100/0	0:35 – 1:25	0:25 – 0:45	0:25 – 0:50 ⁷	0:10 – 0:30 ⁷		
		75/25	0:35 – 1:15	0:25 – 0:50	0:25 – 0:55 ⁷	0:15 – 0:30 ⁷		
below -14 to -27.5	below 7 to -17.5	100/0	0:20 – 0:45	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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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+

**KILFROST TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other 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 ⁷	0:15 – 0:35 ⁷		
		75/25	0:25 – 1:25	0:35 – 1:05	0:20 – 0:55 ⁷	0:09 – 0:30 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

**NEWAVE AEROCHEMICAL TYPE II FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
-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 ⁷	0:15 – 0:20 ⁷		
		75/25	0:30 – 1:05	0:10 – 0:20	0:15 – 0:30 ⁷	0:08 – 0:15 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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 GUIDELINES FOR WINTER 2013-2014

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

Outside Air Temperature ¹		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			Freezing Drizzle ³	Light Freezing Rain	Rain on Cold Soaked Wing ⁴	Other ⁵
				Very Light ²	Light ²	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 ⁶	25 ⁶	10 – 25 ⁶	7 – 10 ⁶	9 – 12 ⁶	6 – 9 ⁶		
below -10	below 14	100/0	20 – 40	30	15 – 30	8 – 15				

NOTES

- 1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type III fluid cannot be used.
- 2 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 3 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 4 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 5 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 6 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 GUIDELINES FOR WINTER 2013-2014¹

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 ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
-3 and above	27 and above	100/0	1:55 – 3:10	0:40 – 1:20	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	0:30 – 0:55	0:20 – 1:00 ⁷	0:10 – 0:25 ⁷		
		75/25	0:25 – 0:50 ⁸	0:20 – 0:40 ⁸	0:15 – 1:05 ^{7,8}	0:10 – 0:25 ^{7,8}		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	0:15 – 0:40 ⁹	0:15 – 0:30 ⁹				

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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.
- 8 For Lyondell Arctic Shield, the temperature is limited to -9.5°C (14.9°F); and 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).
- 9 For Lyondell Arctic Shield, the temperature is limited to -24.5°C (-12.1°F), and for Cryotech Polar Guard, 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

ABAX TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other 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 ⁷	0:15 – 0:30 ⁷		
		75/25	0:25 – 0:50	0:20 – 0:45	0:25 – 1:05 ⁷	0:15 – 0:30 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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-Ecowing AD-49

**ABAX TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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 ⁷	0:20 – 0:25 ⁷		
		75/25	0:30 – 1:10	2:00	1:40 – 2:00	1:20 – 1:40	0:15 – 1:05 ⁷	0:15 – 0:25 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
MAX FLIGHT 04 (formerly Octagon 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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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 ⁷	0:20 – 0:40 ⁷	CAUTION: No holdover time guidelines exist	
		75/25								
below -14 to -26.5	below 7 to -15.7	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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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 ⁷	0:25 – 0:45 ⁷	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 ⁷	0:25 – 0:45 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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+

CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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			Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	Other ⁶
				Very Light ³	Light ³	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	CAUTION: No holdover time guidelines exist
		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 ⁷	0:25 – 0:40 ⁷		
		75/25	0:40 – 2:00	2:00	1:15 – 2:00	0:30 – 1:15	0:20 – 1:05 ⁷	0:20 – 0:30 ⁷		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 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

CRYOTECH TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2013-2014¹
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 ⁶
Degrees Celsius	Degrees Fahrenheit		Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets ³	Freezing Drizzle ⁴	Light Freezing Rain	Rain on Cold Soaked Wing ⁵	
-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 ⁷	0:15 – 0:35 ⁷		
		75/25	0:35 – 1:30 ⁸	0:20 – 0:40 ⁸	0:25 – 1:05 ⁸	0:20 – 0:30 ⁸		
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 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
- 4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
- 5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
- 6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
- 7 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.
- 8 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.

