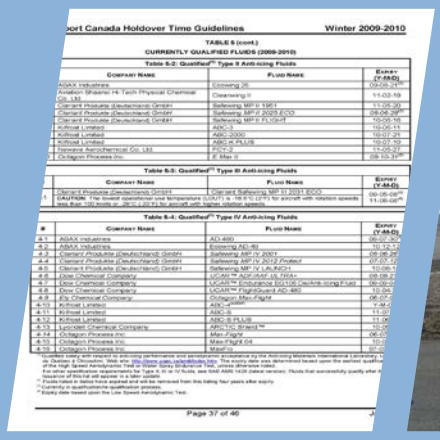
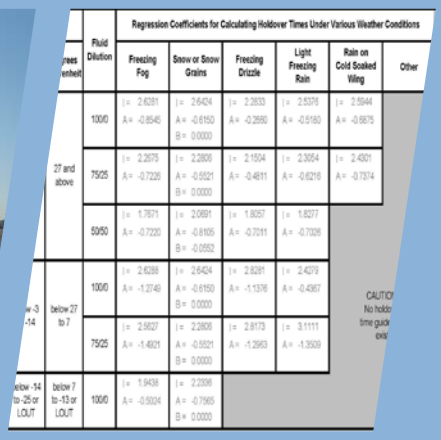
TP 14937E

Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables





Prepared for
Transportation Development Centre

In cooperation with

Civil Aviation
Transport Canada

and

The Federal Aviation Administration
William J. Hughes Technical Center

Prepared by:

APS Aviation Inc.

December 2009
Final Version 1.0

TP 14937E

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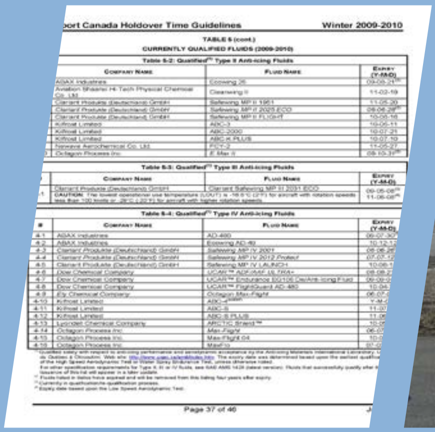

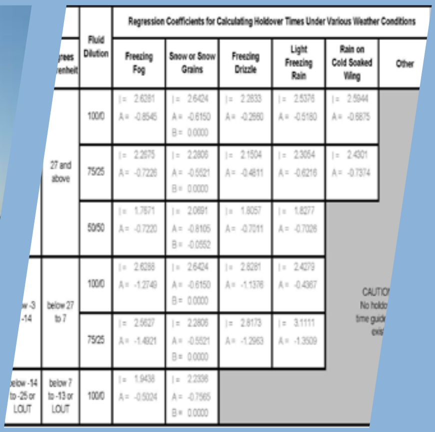

by

Stephanie Bendickson

December 2009
Final Version 1.0

APS Aviation Inc.

The contents of this report reflect the views of APS Aviation Inc. and not necessarily the official view or opinions of the Transportation Development Centre of Transport Canada.

The Transportation Development Centre does not endorse products or manufacturers. Trade or manufacturers' names appear in this report only because they are essential to its objectives.

DOCUMENT ORIGIN AND APPROVAL RECORD

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Un sommaire français se trouve avant la table des matières.

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PREFACE

Under contract to the Transportation Development Centre of Transport Canada, APS Aviation Inc. (APS) has undertaken a research program to advance aircraft ground de/anti-icing technology. The specific objectives of the APS test program are the following:

- To evaluate weather data from previous winters that can have an impact on the format of the holdover time guidelines;
- To develop holdover time data for all newly-qualified de/anti-icing fluids, and update and maintain the website for the holdover time guidelines;
- To conduct endurance time tests in frost on various test or wing surfaces;
- To conduct endurance time tests on non-aluminum plates;
- To conduct endurance time tests to support the removal of the below -25°C row of the holdover time guidelines;
- To conduct general and exploratory de/anti-icing research;
- To conduct endurance time tests to expand the current holdover guidelines to include conditions of rain and snow;
- To evaluate the effect of poor fluid application on fluid endurance times;
- To evaluate holdover times for anti-icing in a hangar;
- To review the use of the visibility table for use with holdover times;
- To conduct research at the NRC wind tunnel to further develop and expand ice pellet allowance times;
- To conduct various aerodynamic research activities at the NRC wind tunnel;
- To initiate research for development of ice detection capabilities for departing aircraft at the runway threshold; and
- To update the regression coefficient report with the newly-qualified de/anti-icing fluids.

The research activities of the program conducted on behalf of Transport Canada during the winter of 2008-09 are documented in seven reports. The titles of the reports are as follows:

- TP 14933E Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2008-09 Winter;
- TP 14934E Winter Weather Impact on Holdover Time Table Format (1995-2009);
- TP 14935E Research for Further Development of Ice Pellet Allowance Times: Wind Tunnel Trials to Examine Anti-Icing Fluid Flow-Off Characteristics Winter 2008-09;
- TP 14936E Aircraft Ground Icing General Research Activities During the 2008-09 Winter;
- TP 14937E Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables;

- TP 14938E Substantiation of Aircraft Ground Deicing Holdover Times in Frost Conditions; and
- TP 14939E Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2008-09.

In addition, the following interim report is being prepared:

- *Endurance Times Using Composite Surfaces.*

This report, TP 14937E, has the following objective:

- To document the regression information required for the winter 2009-10 aircraft ground deicing holdover time tables and to document how and from where the information was obtained.

This objective was met by analyzing data from holdover time testing conducted over the winters of 1996-97 through 2008-09.

PROGRAM ACKNOWLEDGEMENTS

This multi-year research program has been funded by the Civil Aviation Group, Transport Canada with support from the Federal Aviation Administration, William J. Hughes Technical Centre, Atlantic City, NJ. This program could not have been accomplished without the participation of many organizations. APS would therefore like to thank the Transportation Development Centre of Transport Canada, the Federal Aviation Administration, National Research Council Canada, the Meteorological Service of Canada, and several fluid manufacturers.

APS would also like to acknowledge the dedication of the research team, whose performance was crucial to the acquisition of hard data. This includes the following people: Stephanie Bendickson, Matthew Bowen, Chris Burke, Michael Chaput, John D'Avirro, Peter Dawson, Jeff Ford, Benjamin Guthrie, Michael Hawdur, Eric Perocchio, Michelle Pineau, Dany Posteraro, Marco Ruggi, Joey Tiano, David Youssef and Victoria Zoitakis.

Special thanks are extended to Angelo Boccanfuso, Yagusha Bodnar, Frank Eyre, Doug Ingold, and Warren Underwood, who on behalf of the Transportation Development Centre and the Federal Aviation Administration, have participated, contributed and provided guidance in the preparation of these documents.

In memory of the late Barry Myers whose wisdom and knowledge combined with his dedication and perseverance has played a fundamental role in the development of the aircraft ground deicing program. His presence will be missed by all who had the privilege of making his acquaintance.

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PUBLICATION DATA FORM

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15. Supplementary Notes (Funding programs, titles of related publications, etc.)

Several research reports for testing of de/anti-icing technologies were produced for previous winters on behalf of Transport Canada. These are available from the Transportation Development Centre (TDC). Several reports were produced as part of this winter's research program. Their subject matter is outlined in the preface. This project was co-sponsored by the Federal Aviation Administration.

16. Abstract

Transport Canada is required to publish the regression equations and related coefficients used in the development of the holdover time guidelines each winter. For the winter of 2009-10, the regression information will be published online in a document titled *Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-10*.

This report documents how and from where the regression information published in the online document was obtained. Regression data was generated for the generic Type I holdover time table, eight Type II fluid-specific tables, one Type III fluid-specific table, and fifteen Type IV fluid-specific tables. In addition, data was required for Clariant Safewing MP II 1951 and the grandfathered fluid data set in support of the generic Type II holdover time table.

It is recommended that the regression information be updated in one year to reflect any changes made to the holdover time guidelines for the winter of 2010-11.

17. Key Words	18. Distribution Statement
Anti-icing, deicing, deicing fluid, holdover times, precipitation, endurance times, Type I, Type II, Type III, Type IV, aircraft, ground, test, winter, regression, holdover time determination system	Limited number of copies available from the Transportation Development Centre

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	14. Agent de projet Antoine Lacroix pour Angelo Boccanfuso

15. Remarques additionnelles (programmes de financement, titres de publications connexes, etc.)

Plusieurs rapports de recherche sur des essais de technologies de dégivrage et d'antigivrage ont été produits au cours des hivers précédents pour le compte de Transports Canada. Ils sont disponibles au Centre de développement des transports (CDT). Ils sont disponibles au Centre de développement des transports (CDT). Plusieurs rapports ont été produits dans le cadre du programme de recherche de cet hiver. Leur objet apparait à l'avant-propos. Ce projet était coparrainé par la Federal Aviation Administration.

16. Résumé

Chaque hiver, Transports Canada doit publier les équations de régression et les coefficients connexes utilisés pour l'élaboration de lignes directrices sur les durées d'efficacité. Pour l'hiver 2009-10, l'information de régression sera publiée en ligne dans un document qui a pour titre : *Transports canada – Données de régression concernant les lignes directrices sur les durées d'efficacité des liquides (HOT), hiver 2009-2010*.

Ce rapport documente la façon et la source d'obtention de l'information de régression publiée dans le document en ligne. Des données de régression ont été produites pour les tableaux de durées d'efficacité des liquides génériques de type I, pour huit tableaux spécifiques à des liquides de type II, pour un tableau spécifique à des liquides de type III et pour quinze tableaux spécifiques à des liquides de type IV. De plus, des données ont été produites pour le liquide Clariant Safewing MP II 1951 et pour l'ensemble de données existantes du tableau de durées d'efficacité des liquides génériques de type II.

Il est recommandé d'actualiser les deux documents de régression dans un an, afin de refléter tout changement aux lignes directrices sur les durées d'efficacité effectué pour l'hiver 2010-11.

17. Mots clés	18. Diffusion
Antigivrage, dégivrage, liquide de dégivrage, durées d'efficacité, précipitation, temps d'endurance, Type I, Type II, Type III, Type IV, aéronef, sol, essai, hiver, régression, systèmes de détermination de durées d'efficacité	Le Centre de développement des transports dispose d'un nombre limité d'exemplaires

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EXECUTIVE SUMMARY

In recent years, several companies have been developing systems that measure temperature, precipitation type and precipitation rate in real-time. These systems, referred to as holdover time determination systems (HOTDS), use the weather data they collect and holdover time regression information provided to them to calculate holdover times that are more specific than the ranges currently provided in the holdover time guidelines.

In order for HOTDS to be used by Canadian operators, Transport Canada is required to publish the regression equations and related coefficients used in the development of the holdover time guidelines. For the winter of 2009-10, Transport Canada will publish two documents related to the holdover time regression information. The first document, "*Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-10*," will be published online and is meant for HOTDS manufacturers only. It provides the regression equations and related coefficients applicable to the 2009-10 holdover time guidelines and provides guidance for their application and use.

The second document is this report. Its purpose is to document the sources of the regression information and how it was obtained. It also provides the methodology used to determine the generic and fluid-specific holdover times used in the holdover time guidelines.

For the winter 2009-10 guidelines, regression data was generated for the generic Type I holdover time table, eight Type II fluid-specific tables, one Type III fluid-specific table, and fifteen Type IV fluid-specific tables. In addition, data was generated for Clariant Safewing MP II 1951 and the grandfathered fluid data set in support of the generic Type II holdover time table.

The winter 2009-10 data was predominantly obtained from the results of holdover time testing conducted over the winters of 1996-97 to 2008-09. Much of the data had been documented in a previous Transport Canada report and was therefore collected from that report. Additional data was collected from the results of holdover time testing conducted in the winter of 2008-09, including data for three newly certified fluids: Aviation Shaanxi Cleanwing II (Type II), ABAX Ecowing AD-49 (Type IV), and Kilfrost ABC-4^{sustain} (Type IV).

The regression coefficient tables will be published online in January 2010. The data in the tables can be used by HOTDS to calculate holdover times during the winter of 2009-10.

It is recommended that both regression documents be updated in one year to reflect any changes made to the holdover time guidelines for the winter of 2010-11.

SOMMAIRE

Au cours des dernières années, plusieurs entreprises ont élaboré des systèmes qui mesurent la température, le type de précipitation et le taux de précipitation en temps réel. Ces systèmes, appelés systèmes de détermination des durées d'efficacité (HOTDS), utilisent les données météorologiques recueillies et l'information sur la régression des durées d'efficacité qui leur est fournie, pour calculer des durées d'efficacité qui sont plus spécifiques que celles des plages actuellement obtenues dans les lignes directrices sur les durées d'efficacité.

Pour que les HOTDS soient utilisés par les exploitants canadiens, Transports Canada doit publier les équations de régression et les coefficients connexes lors de l'élaboration de lignes directrices sur les durées d'efficacité. Pour l'hiver 2009-2010, Transports Canada publiera deux documents d'information sur la régression des durées d'efficacité. Le premier document, « *Transports Canada – Données de régression concernant les lignes directrices sur les durées d'efficacité des liquides (HOT), hiver 2009-2010* », sera publié en ligne à l'intention des fabricants de HOTDS seulement. Il fournit les équations de régression et les coefficients connexes, applicables aux lignes directrices de 2009-2010 sur les durées d'efficacité, ainsi que des conseils sur leur application et utilisation.

Le deuxième document est le présent rapport. Il vise à documenter les sources de l'information de régression et comment elle a été obtenue. Il précise également la méthodologie utilisée pour établir les durées d'efficacité génériques et spécifiques utilisées pour les lignes directrices sur les durées d'efficacité.

Dans le cas des lignes directrices de l'hiver 2009-2010, des données de régression ont été produites pour les tableaux de durées d'efficacité des liquides génériques de type I, pour huit tableaux spécifiques à des liquides de type II, pour un tableau spécifique à un liquide de type III et pour quinze tableaux spécifiques à des liquides de type IV. De plus, des données ont été produites pour le liquide Clariant Safewing MP II 1951 et pour l'ensemble de données existant du tableau de durées d'efficacité des liquides génériques de type II.

Les données de l'hiver 2009-2010 ont été principalement obtenues à partir des résultats d'essais sur les durées d'efficacité tenus au cours des hivers 1996-1997 à 2008-2009. Plusieurs des données avaient été documentées dans un rapport précédent de Transports Canada et provenaient en conséquence de ce rapport. Des données additionnelles ont été obtenues à partir des résultats d'essais sur les durées d'efficacité tenus au cours de l'hiver 2008-2009, y compris les données sur trois liquides nouvellement certifiés : Aviation Shaanxi Cleanwing II (type II), ABAX Ecowing AD-49 (type IV) et Kilfrost ABC-4^{sustain} (type IV).

CONTENTS Page

LIST OF APPENDICES

LIST OF TABLES

Page

LIST OF FIGURES

Page

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GLOSSARY

APS	APS Aviation Inc.
ARP	Aerospace Recommended Practice
CAR	Canadian Aviation Regulation
FAA	Federal Aviation Administration
HOT	Holdover Time
HOTDS	Holdover Time Determination Systems
MSC	Meteorological Service of Canada
NRC	National Research Council Canada
TDC	Transportation Development Centre

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1. INTRODUCTION

For more than a decade, the Transportation Development Centre (TDC), Transport Canada has managed and conducted research related to aircraft ground operations under winter precipitation conditions. The objective of the research program is to reduce the risks inherent in taking off in hazardous winter weather, particularly in snow, freezing precipitation, and following overnight frost conditions. As part of this program, TDC has undertaken research at various sites in Canada and has coordinated worldwide testing. Research has been conducted with the co-operation of the United States Federal Aviation Administration (FAA), the National Research Council Canada (NRC), the Meteorological Service of Canada (MSC), several major airlines, and de/anti-icing fluid manufacturers.

1.1 Background

Determining holdover times for de/anti-icing fluids and developing guidelines for their use has been a focus of the Transport Canada Ground Icing Research Program since its inception. The Transport Canada Holdover Time Guidelines provide pilots with tables of the protection times provided by de/anti-icing fluids in winter conditions. The values in the holdover time tables are developed by conducting regression analysis of flat-plate test data collected with de/anti-icing fluids. The guidelines are revised and republished annually to account for the results of additional testing with new and current fluids.

Aircraft de/anti-icing fluid holdover time is a function of fluid dilution, precipitation rate, precipitation type and ambient temperature. Although the current methodology for determining holdover times enables values to be calculated at virtually any temperature and precipitation rate, it is neither practical nor feasible to include all of this information in the holdover time guidelines. Instead, holdover times are organized into tables that are divided into cells by precipitation type, temperature range, and fluid dilution. Within each of these cells, upper and lower values are given based on predetermined lower and upper precipitation rate limits and the lowest temperature in the temperature range.

In recent years, several companies have been developing systems that measure temperature, precipitation type and precipitation rate in real-time. These systems, referred to as holdover time determination systems (HOTDS), use the weather data they collect and holdover time regression information to calculate more specific holdover times than the ranges that are currently provided in the holdover time guidelines. These times can be relayed directly to the cockpit. There are several advantages to be gained by using HOTDS in place of the traditional holdover time tables:

1. **Extended Holdover Times:** Whereas holdover time table values are calculated based on the lowest temperature in each temperature range and the highest precipitation rate in each precipitation category, HOTDS can calculate values at any temperature or precipitation rate, and therefore users may be provided with longer holdover times in some conditions;
2. **Ease of Use:** HOTDS are more user-friendly than holdover time tables as pilots are provided with a single holdover time; they do not have to determine the appropriate holdover time themselves by looking up specific weather conditions in the appropriate holdover time table, nor do they have to interpret the range of holdover time provided; and
3. **Environmental and Cost Savings:** The information provided by HOTDS enables pilots to make better fluid selection decisions. This is forecast to increase the use of Type I fluid and decrease the use of Type IV fluid, potentially resulting in cost and environmental savings.

1.2 Transport Canada's Role

In order for HOTDS to be used by Canadian operators, Transport Canada must:

1. Provide regulations that allow the use of HOTDS by Canadian operators; and
2. Publish the regression equations and related coefficients that are used in the development of the Transport Canada holdover time tables.

1.2.1 Regulations for HOTDS Use

Transport Canada has supported the development of HOTDS and has taken an active role in developing regulations for HOTDS use in Canada. The short-term methodology employed by Transport Canada to implement the use of HOTDS outputs in Canadian air operations included the development of two documents:

1. A **performance standard** defining the minimum quality assurance requirements (quality management system; training and qualifications; installation, siting, operation and maintenance) and minimum performance specifications (system accuracy; technical requirements for data inputs and holdover time determinations) for HOTDS; and
2. An **air carrier exemption** from Canadian Aviation Regulation (CAR) 622.11 for the operational use of the holdover time information provided by the HOTDS.

Transport Canada developed a performance standard in the winter of 2006-07 and an air carrier exemption for WestJet the same winter. The performance standard is provided as an appendix to the WestJet exemption document.

1.2.2 Publication of Regression Equations and Related Coefficients

The regression equations and coefficients used to calculate the values in the holdover time tables are required for HOTDS to function. As indicated in the following excerpt from the performance standard, the regression information must be provided by Transport Canada or an equally valid source.

> *5.1.12 The HOTDS shall incorporate the most current regression curves and associated coefficients. These regression curves and associated coefficients are:*
>
> *5.1.12.1 Those obtained from or published by Transport Canada, or*
>
> *5.1.12.2 Those where traceability and validity [have been] demonstrated to be equivalent to those in 5.1.12.1.*
>
> *5.1.13 Holdover Time Determinations from the system for all de/anti-icing fluids shall be computed using the regression curves and associated coefficients referenced in 5.1.12.*

Transport Canada first published regression information in the fall of 2008 in the report, TP 14873E, *Regression Coefficients and Equations Used to Develop the Winter 2008-09 Aircraft Ground Deicing Holdover Time Tables* (1). The report documented the process that was taken to create the initial regression information database and contains the regression information relevant to the 2008-09 holdover time guidelines.

Subsequent to the publication of TP 14873E (1), Transport Canada determined it would be necessary to publish two documents related to the regression information annually. The purpose of the first document would be to provide users with the regression information and guidance material for its application and use. The document would be entitled *"Transport Canada Holdover Time (HOT) Guidelines Regression Information [current winter]"* and would be published online with the Holdover Time Guidelines.

The purpose of the second document would be to document how and from where the regression information published in the first document (the online document) was obtained. The report would be entitled "*Regression Coefficients and Equations Used to Develop the Winter [current winter] Aircraft Ground Deicing Holdover Time Tables*" and would be published as a Transport Canada report with a TP number. This document is that report for Winter 2009-10.

Most users will find all of the information they require in the first document. The second document is a reference document completed for the purpose of documentation only. It is not expected the second document will be referred to by

users, unless they want a better understanding of how the values in the holdover time tables are derived (something that does not have to be understood to use the regression information with HOTDS). The two documents relevant for the Winter 2009-10 season are described in Table 1.1.

As all regression information relevant to the current winter operating season is contained in the two documents published annually, the first Transport Canada report on regression information, TP 14873, is now obsolete.

1.3 Objectives

The primary objective of this report is to document how and from where the regression information published online for the 2009-10 winter holdover time guidelines was obtained. A secondary objective is to document the methodology used to determine holdover times.

The detailed objectives of this project are provided in an excerpt from the Transport Canada statement of work, which has been provided in Appendix A.

1.4 Report Format

The following list provides short descriptions of subsequent sections of this report:

- Section 2 describes the methodology used to determine holdover times;
- Section 3 presents the data collection methodology;
- Section 4 describes the regression coefficient data;
- Section 5 presents conclusions derived from the analysis; and
- Section 6 lists recommendations for future work.

1.5 Note on Frost

Fluid-specific holdover times are currently not provided for frost conditions; generic holdover times are provided for each of the four fluid types in a separate frost holdover time table.

As regression coefficients and equations are not currently used in the determination of frost holdover times, regression information is not included for frost in the published regression documents.

Table 1.1: Documents Relevant to 2009-10 Regression Information

Document Name	Publication Type / Location	Purpose	Contents
Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-10	Online publication, available on the Holdover Time Guidelines website	To provide regression information and guidance on its usage to users	• Regression equations and coefficients required for all holdover time tables in Winter 2009-10 Holdover Time Guidelines • Guidance for application and use of regression information, including procedure for calculating generic holdover times
Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables	Transport Canada TP report, available from Transport Canada	To document the source of the regression information provided in the online publication	• Methodology used to obtain regression information • Source locations for current winter's regression information • Methodology used to determine holdover time values used in holdover time guidelines • Copy of the online publication containing the regression information for Winter 2009-10 (provided as an appendix)

1.6 Note on Allowance Times

The holdover time guidelines currently contain "allowance times" for ice pellets and ice pellets mixed with several other types of precipitation, including freezing rain, freezing drizzle, rain and snow. The allowance times are not fluid-specific and are not based on regression analysis.

As regression coefficients and equations are not currently used in the determination of allowance times, regression information is not included for allowance times, ice pellets or ice pellets mixed with other types of precipitation in the published regression documents.

1.7 Validity of Regression Coefficient Data for FAA Guidelines

The regression information documented in this report was prepared for Transport Canada to be used in conjunction with the Transport Canada Holdover Time Guidelines. The FAA publishes a separate set of guidelines for operators in the United States. For the most part, the Transport Canada and FAA guidelines contain the same holdover time values; however, several minor differences exist between the Transport Canada and FAA Type I and Type III generic holdover time tables. These differences are detailed in Subsections 2.4.1 and 2.4.3. They are also detailed in footnotes to the affected regression coefficients tables in the online document (included as Appendix B). It remains the responsibility of the user to ensure the appropriate application of the data provided in this report.

2. METHODOLOGY FOR THE DETERMINATION OF HOLDOVER TIMES

The methodologies that are used to determine the holdover times given in the Transport Canada Holdover Time Guidelines are presented in this section.

2.1 Background

Determining holdover times is one step in the fluid qualification process. The complete process for qualification of Type I, II, III and IV fluids is documented in SAE Aerospace Recommended Practice (ARP) 5718 (2).

There are two steps involved in determining holdover times. The first step is endurance time testing and the second step is calculating holdover times from the results of the endurance time testing.

2.2 Endurance Time Testing

Endurance time tests are conducted to measure the amount of protection time that de/anti-icing fluids offer against ice formation. These tests are carried out on flat plates in natural and simulated precipitation conditions.

Test procedures to measure endurance times have evolved into a refined standard approach that has been followed since 1990. Since that time, endurance time testing for the purpose of developing holdover times has been conducted by APS Aviation Inc. (APS) on behalf of Transport Canada and the FAA.

2.2.1 Freezing Precipitation

Freezing fog, freezing rain, light freezing drizzle and cold-soaked wing endurance time tests are conducted in simulated (laboratory) conditions. For each cell in the holdover time table, four tests are conducted at the lowest temperature in the temperature range of the cell: two tests are conducted at the low precipitation rate and two tests are conducted at the high precipitation rate for the precipitation type for a total of four tests per cell.

The precipitation rate limits for freezing precipitation are as follows[1]:

- Freezing fog: 2 and 5 g/dm^2/h;
- Freezing drizzle: 5 and 13 g/dm^2/h;
- Light freezing rain: 13 and 25 g/dm^2/h; and
- Rain on cold-soaked wing: 5 and 75 g/dm^2/h.

2.2.2 Snow

Snow endurance time tests are conducted in natural conditions where temperature and precipitation rate cannot be controlled. Therefore, the protocol for measuring endurance times in snow is slightly different: tests are conducted in natural snow in a range of temperatures and precipitation rates.

The precipitation rate limits used in the holdover time guidelines for snow are as follows[2]:

- Very Light Snow[3]: 4 g/dm^2/h;
- Light Snow: 4 and 10 g/dm^2/h; and
- Moderate Snow: 10 and 25 g/dm^2/h.

2.3 Protocol for Calculating Fluid-Specific Holdover Times

Fluid-specific holdover times are calculated for all Type II, Type III and Type IV fluids submitted for holdover time testing. The Type II and Type IV fluid-specific holdover times are used to develop fluid-specific holdover time tables and to determine the values in the generic Type II and Type IV holdover time tables. The Type III fluid-specific holdover times are calculated to ensure new Type III fluids meet the minimum holdover times set in the generic Type III holdover time table.

The protocol for calculating holdover times differs for freezing precipitation and for snow. The freezing precipitation protocol is described in Subsection 2.3.1; the snow protocol is described in Subsection 2.3.2.

[1] Significant research has gone into the selection of these values. See Subsection 2.9.1 of Transport Canada report TP 14144E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2002-03 Winter* (3).
[2] These definitions are not directly correlated to meteorological observations.
[3] While the Transport Canada holdover time guidelines define very light snow with a single precipitation rate limit (4 g/dm^2/h), the FAA guidelines include both a lower limit (3 g/dm^2/h) and upper limit (4 g/dm^2/h) for very light snow.

2.3.1 Freezing Precipitation Holdover Times

The following steps are used to calculate holdover times in freezing precipitation.

1. For each cell in a holdover table of the given fluid type, a best-fit power law curve is developed from the tests conducted at the low and high precipitation rate condition of that cell using regression analysis. The equation used to treat the data is $\mathbf{t = 10^{I} R^{A}}$, where:

    - t = time (minutes);
    - R = rate of precipitation (g/dm^2/h); and
    - I, A = coefficients determined from the regression.

2. Holdover times are calculated for the low and high precipitation rate limits for each precipitation type (see Subsection 2.2.1) using the resulting regression equation.

3. For Type II and Type IV fluids, the regression-generated holdover times are subject to rounding rules:

    - Values are rounded to the nearest whole "5" digit. For example, 55.1 to 57.4 minutes is rounded down to 55 minutes; 57.5 to 59.9 minutes is rounded up to 60 minutes;
    - In cases where the regression-generated holdover times are below 10 minutes, the numbers are rounded down as a precautionary measure. For example, 9 minutes is rounded down to 5 minutes;
    - Freezing drizzle, freezing rain, and rain on cold-soaked wing values are capped at 2 hours; and
    - Freezing fog values are capped at 4 hours.

2.3.2 Snow Holdover Times

The following steps are used to calculate holdover times in snow.

1. The data is grouped by fluid dilution. The data set for each fluid dilution is subjected to a multi-variable regression analysis. The general form of the regression equation is $\mathbf{t = 10^{I} R^{A} (2\text{-}T)^{B}}$, where:

    - t = time (minutes);
    - R = rate of precipitation (g/dm^2/h);
    - T = temperature (°C); and
    - I, A, B = coefficients determined from the regression.

2. This results in one regression equation for each fluid dilution in snow. Holdover times are calculated for the precipitation limits of each cell by using the appropriate regression equation and the most restrictive (lowest) temperature in the cell.

3. For Type II and Type IV fluids, the regression-generated holdover times are subject to rounding rules:

    - Values are rounded to the nearest whole "5" digit. For example, 55.1 to 57.4 minutes is rounded down to 55 minutes; 57.5 to 59.9 minutes is rounded up to 60 minutes;
    - In cases where the regression-generated holdovers are below 10 minutes, the numbers are rounded down as a precautionary measure. For example, 9 minutes is rounded down to 5 minutes; and
    - Snow values are capped at 2 hours.

4. With the exception of Dow UCAR Ultra+, all Type II and Type IV fluids are given generic values in the "below -14 to -25°C snow cell". This decision was made following the winter of 2003-04, due to very limited endurance time test data existing for most fluids at these temperatures.

2.4 Protocol for Calculating Generic Holdover Times

The protocol used to determine generic holdover time table values is unique to each fluid type.

2.4.1 Type I Generic Holdover Times

The values in the Type I generic holdover time table are static. This is largely due to a significant body of research and testing that indicates that all Type I fluids formulated with glycol perform in a similar manner from an endurance time perspective. In fact, regulators no longer require the endurance times of Type I deicing fluids formulated with propylene glycol, ethylene glycol or diethylene glycol be measured. Endurance times of fluids formulated with other glycol bases or with non-glycol bases are still measured to ensure their performance is similar to the values in the generic Type I table.

The freezing precipitation values in the Type I generic table were established in the early 1990s and substantiated by testing conducted up to and including the winter of 1995-96. One exception is the values in the "below -3 to -6°C" row, which were added to the Type I generic table in the winter of 2003-04. Testing was conducted with five Type I fluids in the winter of 2002-03 to determine appropriate values for

the "below -3 to -6°C" row[4]. Type I freezing precipitation values were not established using regression analysis (though they have since been substantiated with regression analysis). Therefore, regression coefficients do not currently exist for the freezing precipitation values in the Type I table.

A new protocol for conducting Type I tests in natural snow was established in the winter of 2001-02. Testing was conducted that winter with the new test protocol and a number of Type I fluids[5]. Regression analysis was conducted on the data collected to produce the snow values that have been in the Type I generic table since the winter of 2002-03.

It should be noted that the FAA Type I generic holdover time table differs from the Transport Canada table in two places:

1. **Very Light Snow Cells:** The Transport Canada table provides one holdover time in each very light snow cell which is based on a rate of 4 g/dm^2/h; the FAA table provides two values in each cell based on rates of 3 and 4 g/dm^2/h.

2. **Light Freezing Rain *"-3°C and above"* and *"below -3 to -6°C"* Cells:** The Transport Canada table gives a holdover time range of 4 to 6 minutes; the FAA table gives a holdover time range of 2 to 5 minutes.

2.4.2 Type II Generic Holdover Times

Prior to the winter of 1998-99, holdover time data points were collected with all qualified Type II fluids and amalgamated into one Type II fluid data set. The data set was used to determine appropriate holdover times for the generic Type II guidelines. Fluid-specific guidelines did not exist, and regression analysis was not used in the calculation of holdover times.

Starting in the winter of 1998-99, holdover time data was collected with each Type II fluid submitted for testing under the complete set of conditions in the holdover time guidelines (with the exception of frost, see Subsection 1.5). Regression analysis was applied to each individual fluid data set; this analysis enabled publication of the first fluid-specific Type II guidelines.

Fluid-specific guidelines were never produced for fluids originally submitted for testing before this protocol was introduced. However, these pre-1998-99 tested

[4] The selection of freezing precipitation values for the "below -3 to -6°C" row is documented in the Transport Canada report TP 14144E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2002-03 Winter,* Section 8.4.2 (3).

[5] Tests are documented in the Transport Canada report TP 13994E, *Generation of Holdover Times Using the New Type I Fluid Test Protocol* (4).

fluids, dubbed "grandfathered" fluids, remained on the list of qualified fluids and could be used with the generic guidelines.

When fluid-specific guidelines were introduced, the protocol for determining values in the Type II generic table changed. The generic table values had to reflect the worst-case holdover time value of all available Type II fluids. The values in the fluid-specific guidelines were compared to determine the worst-case value for all new fluids, but this methodology excluded the grandfathered fluids. To account for the performance of the grandfathered fluids, the values in the 1998-99 generic guidelines were included in the Type II generic analysis comparison. The 1998-99 data set is now referred to as the grandfathered fluid data set.

In addition, since Type IV fluids also qualify as Type II fluids, all qualified Type IV fluids must also be included in the generic Type II analysis.

In summary, each generic Type II holdover time is determined by taking the shortest holdover time of the following data sets:

1. All fluids on the list of qualified Type II fluids (given as Table 5-2 in the Transport Canada Holdover Time Guidelines, see also Subsection 2.5), except "grandfathered" fluids;
2. The "grandfathered fluid" data set, which includes values equivalent to the 1998-99 generic Type II holdover times; and
3. All fluids on the list of qualified Type IV fluids (given as Table 5-4 in the Transport Canada Holdover Time Guidelines, see also Subsection 2.5).

Because each value in the generic Type II holdover time table is evaluated individually, different fluids may be responsible for the upper and lower values in a cell.

The generic Type II holdover time table is revised each year a Type II fluid is added or removed from the list of qualified fluids. Minor changes are made regularly.

2.4.3 Type III Generic Holdover Times

Like the Type I generic holdover time table, the values in the Type III generic holdover time table are static. The values in the table have been fixed since they were established in the winters of 2004-05 (100/0) and 2005-06 (75/25 and 50/50).

The values in the Type III generic guidelines are based on the endurance times of Clariant Safewing MP III 2031 ECO, which is currently the only qualified Type III fluid. The following protocol was used to obtain the generic values:

1. Endurance time tests were conducted with Clariant Safewing 2031;
2. Fluid-specific holdover times were calculated for Clariant Safewing 2031;
3. The fluid-specific values were reduced by 10 percent; and
4. Discretion was used to change the reduced values to relatively round values.

At the time the current Type III guidelines were developed, regulators did not intend to produce fluid-specific tables for Type III fluids. This was because they did not believe that any new fluids would perform significantly better than Clariant Safewing 2031 and they thought that by reducing and rounding the test values they could establish minimum holdover times that any new Type III fluids submitted for testing would meet.

It should be noted that the FAA Type III generic holdover time table differs from the Transport Canada table in the very light snow cells. The Transport Canada table provides one holdover time in each very light snow cell which is based on a rate of 4 g/dm^2/h; the FAA table provides two values in each cell based on rates of 3 and 4 g/dm^2/h.

2.4.4 Type IV Generic Holdover Times

The values in the Type IV generic holdover time table are generated by taking the shortest holdover times of all fluids on the list of qualified Type IV fluids (Table 5-4 in the Transport Canada Holdover Time Guidelines, see also Subsection 2.5). Unlike the Type II analysis, there is no grandfathered fluid data required or included in the analysis.

Because each number in the generic Type IV holdover time table is evaluated individually, different fluids may be responsible for the upper and lower values in a cell.

The generic Type IV holdover time table is revised each year a Type IV fluid is added or removed from the list of qualified fluids. Minor changes are made regularly.

2.5 Note on Qualified Fluids

It should be noted that when the qualification of a Type II or Type IV fluid expires and is not renewed, the fluid remains in the holdover time guidelines for four years: the fluid remains on the list of qualified fluids (Table 5 in the holdover time guidelines), the fluid data remains in the generic table analysis, and if the fluid has a fluid-specific table the table remains in the guidelines. This is done to allow operators

who have inventory of these fluids when the fluid qualification expires to use the fluid rather than having to dispose of it (this assumes the fluid passes any required quality control checks).

The result of this protocol is that all fluids included in the holdover time guidelines may not actually be qualified.

The regression information is provided in support of the holdover time guidelines and therefore it includes information for all fluids that appear in the holdover time guidelines, not just fluids that are currently qualified.

The protocol for the removal of obsolete Type II and Type IV fluid data is provided in SAE ARP 5718, Subsection 5.12.3 (2). The protocol stipulates fluids be removed from the holdover time guidelines four years after fluid qualification has expired.

3. DATA COLLECTION

3.1 Initial Data Collection / Data Base

Until recently, regression coefficient data for aircraft deicing and anti-icing fluid holdover times had not been published in a format appropriate for use with HOTDS. Regression coefficient data was previously published only as part of the annual report on holdover time testing conducted by APS, and only the regression coefficients for the fluids tested in a given year were published each year.

HOTDS require the publication of the regression coefficient data underlying each of the holdover time tables in the current winter's holdover time guidelines. The publication must be updated annually, as changes are made to the holdover time guidelines annually.

The first regression coefficients publication was developed over the winters of 2006-07 and 2007-08 in support of the winter 2008-09 holdover time guidelines. As the regression coefficients had not been published in the format required for HOTDS before this time, and because the required data had to be collected and de-archived from a number of locations, several steps were required to produce the initial data set:

1. The fluids for which data was required were identified;
2. The relevant data set(s) for each fluid were identified;
3. The relevant data set(s) were de-archived;
4. The data set responsible for each holdover time value was determined for fluids with multiple data sets;
5. Regression coefficients were created for cell values not derived directly from regression analysis;
6. The data was amalgamated into a series of tables; and
7. A verification exercise was completed to ensure the selected data was correct.

A complete description of the work completed to create the initial database is provided in the Transport Canada report, TP 14873, *Regression Coefficients and Equations Used to Develop the Winter 2008-09 Aircraft Ground Deicing Holdover Time Tables* (1).

3.2 Data Required/Collected for 2009-10 Holdover Time Guidelines

The data required to publish the regression information for the 2009-10 holdover time guidelines is identified in this section. Much of the data required was previously documented in the regressions coefficients publication for the 2008-09 holdover time guidelines (TP 14873, see Subsection 3.1) and therefore was readily available. Additional data was collected as required.

The data requirements and data collection for 2009-10 are described in the following subsections by fluid type: Subsection 3.2.1 describes the Type I data, Subsection 3.2.2 describes the Type II data, Subsection 3.2.3 describes the Type III data and Subsection 3.2.4 describes the Type IV data.

3.2.1 Type I

Regression information was required for the generic Type I holdover time table. Fluid-specific regression information was not required as fluid-specific holdover time tables are not published for Type I fluids.

The 2001-02 Type I snow data set was required, as it was used to determine snow values in the Type I generic table (see Subsection 2.4.1). The Type I freezing precipitation holdover times are not derived from regression analysis (see Subsection 2.4.1). The Type I freezing precipitation coefficients were created in 2007-08 from the values in the Type I holdover time table.

The regression information for the Type I generic holdover time table was collected previously (see Table 3.1). Since no changes were made to the Type I holdover time guidelines for the winter of 2009-10, no additional Type I data was required or collected this year.

3.2.2 Type II

Regression information was required for the Type II fluid-specific holdover time tables and the Type II generic holdover time table.

3.2.2.1 Fluid-specific

There are eight Type II fluid-specific holdover time tables in the 2009-10 holdover time guidelines. Regression information was required for each of these tables.

The Type II fluid-specific regression information was derived from holdover time testing conducted with the associated Type II fluids. The holdover time testing has been carried out over many years (see Table 3.1).

Regression information for seven of the Type II fluids was collected previously (see Table 3.1):

1. ABAX Ecowing 26;
2. Clariant Safewing MP II 2025 ECO;
3. Clariant Safewing MP II Flight;
4. Kilfrost ABC-2000;
5. Kilfrost ABC-K Plus;
6. Newave Aerochemical FCY-2; and
7. Octagon E Max II.

Regression information for the eighth fluid, which was newly certified for the winter of 2009-10, was collected from the Transport Canada Report TP 14933E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2008-09 Winter* (5), which documents the results of holdover time testing conducted with this fluid:

8. Aviation Shaanxi Hi-tech Cleanwing II.

It should be noted that Aviation Xi'an Hi-tech KHF-II and Kilfrost ABC-II Plus were removed from the holdover time guidelines in 2009-10. Their regression coefficients tables were correspondingly removed from the online regression information document.

3.2.2.2 Generic

The generic Type II holdover time table values are based on the holdover times of all qualified Type II and Type IV fluids. As fluid-specific holdover time tables do not exist for all qualified Type II fluids, some additional regression information is required to enable calculation of generic Type II holdover times. Regression coefficients and equations are required for the following:

1. All Type II fluids with fluid-specific holdover time tables (listed in Subsection 3.2.2.1);
2. All Type IV fluids with fluid-specific holdover time tables (listed in Subsection 3.2.4.1);

3. Clariant Safewing MP II 1951 (because the fluid-specific holdover times are not published for this fluid, but they are used to calculate the Type II generic holdover times); and

4. Type II grandfathered fluid data set (to account for the holdover times of Kilfrost ABC-3, see Subsection 2.4.2).

All of the regression information listed above is derived from holdover time testing conducted with the associated fluids except for the grandfathered fluid data set. The grandfathered fluid regression coefficients were created in 2007-08 from the values in the 1998-99 Type II generic guidelines (see Subsection 2.4.2).

It should be noted that the grandfathered fluid data set and Clariant Safewing MP II 1951 regression coefficients may not be used to derive fluid-specific holdover times for Clariant Safewing MP II 1951, grandfathered fluid Kilfrost ABC-3, or any other fluid.

Regression information for Clariant Safewing MP II 1951 and the grandfathered fluid data set was collected previously (see Table 3.1). The collection of the regression information for Type II fluids with fluid-specific holdover time tables is described in Subsection 3.2.2.1, and in Subsection 3.2.4.1 for Type IV fluids with fluid-specific holdover time tables.

3.2.3 Type III

As only one Type III fluid is currently qualified, regulators have elected to publish fluid-specific regression information for this fluid, Clariant Safewing MP III 2031 ECO, rather than regression information for the generic Type III holdover time table.

The Type III fluid-specific regression information is derived from holdover time testing conducted with the associated Type III fluid. The holdover time testing was carried out over several winters (see Table 3.1).

The regression information for Clariant Safewing MP III 2031 ECO was collected previously (see Table 3.1). Since no changes were made to the Type III holdover time guidelines for the winter of 2009-10, no additional Type III data was required or collected this year.

3.2.4 Type IV

Regression coefficient data was required for the Type IV fluid-specific holdover time tables and the Type IV generic table.

3.2.4.1 Fluid-specific

There are fifteen Type IV fluid-specific holdover time tables in the 2009-10 holdover time guidelines. Regression information was required for each of these tables.

The Type IV fluid-specific regression information was derived from holdover time testing conducted with the associated Type IV fluids. This holdover time testing has been carried out over many years (see Table 3.1).

Regression information for thirteen of the fluids was collected previously (see Table 3.1):

1. ABAX / Dow UCAR AD-480;
2. Clariant Safewing MP IV 2001;
3. Clariant Safewing MP IV 2012 Protect;
4. Clariant Safewing MP IV Launch;
5. Dow Chemical UCAR FlightGuard AD-480;
6. Dow Chemical UCAR™ ADF/AAF ULTRA+;
7. Dow Chemical UCAR™ Endurance EG106;
8. Kilfrost ABC-S;
9. Kilfrost ABC-S Plus;
10. Lyondell ARCTIC Shield;
11. Octagon Max-Flight;
12. Octagon Max-Flight 04; and
13. Octagon MaxFlo.

Regression information for the remaining two fluids, which were newly certified for 2009-10, was collected from the Transport Canada Report TP 14933E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2008-09 Winter* (5), which documents the results of holdover time testing conducted with these fluids:

14. ABAX Ecowing AD-49; and
15. Kilfrost ABC-4^{sustain}.

No Type IV fluids were removed from the holdover time guidelines in 2009-10.

3.2.4.2 Generic

The generic Type IV holdover time table is based on the shortest holdover times of the fluids on the list of qualified Type IV fluids. As fluid-specific holdover time tables exist for all Type IV fluids, no additional regression information is required to calculate generic Type IV holdover times.

3.3 Summary

Table 3.1 lists each set of regression coefficients and equations that are required for the 2009-10 holdover time guidelines. The first column specifies the fluid type / data set name, the second column specifies the source data for the regression information, and the third column indicates the year the data set was first included in Transport Canada's regression information documents.

It should be noted that multiple data sets exist for some fluids. In these cases, the data is examined to determine which data set is responsible for the fluid-specific values in the associated holdover time table. In some cases, the regression coefficients from both data sets have to be included in the final information as the upper and lower values in a cell are derived from different data sets.

Some regression coefficients are not derived directly from regression analysis of holdover time test data (specifically, Type I freezing precipitation values and Type II grandfathered fluid data set values). To obtain regression coefficients for these data sets, each cell value was assumed to be a test data point and these data points were regressed to determine the regression coefficients for the resulting best-fit curves.

Table 3.1: Regression Data Sets and Data Sources

Fluid Type: Data Set Name	Source of Regression Data	Year Added to Regression Publication
Type I: Generic	HOT Testing: 2001-02 (NS) Created from HOT table values (ZF,ZR,ZD,CS)	2008-09
Type II: ABAX Ecowing 26	HOT Testing: 2000-01	2008-09
Type II: Aviation Shaanxi Cleanwing II	HOT Testing: 2008-09	2009-10
Type II: Clariant Safewing MP II 1951	HOT Testing: 1999-00	2008-09
Type II: Clariant Safewing MP II 2025 ECO	HOT Testing: 2002-03	2008-09
Type II: Clariant Safewing MP II Flight	HOT Testing: 2005-06	2008-09
Type II: Grandfathered Fluid Data Set	Created from 1998-99 Type II generic values	2008-09
Type II: Kilfrost ABC-2000	HOT Testing: 2001-02	2008-09
Type II: Kilfrost ABC-K Plus	HOT Testing: 2007-08	2008-09
Type II: Newave Aerochemical FCY-2	HOT Testing: 2006-07	2008-09
Type II: Octagon E Max II	HOT Testing: 2001-02	2008-09
Type III: Clariant Safewing MP III ECO	HOT Testing: 2004-05 (100/0), 2005-06 (75/25,50/50)	2008-09
Type IV: ABAX AD-480	HOT Testing: 1997-98 (NS,ZR,ZD), 1998-99 (NS), 1999-00	2008-09
Type IV: ABAX Ecowing AD-49	HOT Testing: 2008-09	2009-10
Type IV: Clariant Safewing MP IV 2001	HOT Testing: 1997-98 (NS,ZR,ZD), 1999-00 (ZF,CS)	2008-09

Table 3.1: Regression Data Sets and Data Sources (cont'd)

Fluid Type: Data Set Name	Source of Regression Data	Year Added to Regression Publication
Type IV: Clariant Safewing MP IV 2012 Protect	HOT Testing: 2000-01	2008-09
Type IV: Clariant Safewing MP IV Launch	HOT Testing: 2005-06 (ZF,ZR,ZD,CS), 2006-07 (NS)	2008-09
Type IV: Dow UCAR FlightGuard AD-480	HOT Testing: 1997-98 (NS,ZR,ZD), 1998-99 (NS), 1999-00	2008-09
Type IV: Dow UCAR ADF/AAF ULTRA +	HOT Testing: 1996-97 (NS,ZR,ZD), 1998-99 (ZF,ZR,ZD,CS)	2008-09
Type IV: Dow UCAR™ Endurance EG106	HOT Testing: 2005-06	2008-09
Type IV: Kilfrost ABC-4^{sustain}	HOT Testing:2008-09	2009-10
Type IV: Kilfrost ABC-S	HOT Testing: 1996-97 (NS,ZR,ZD),1997-98 (ZR,ZD,CS), 1998-99	2008-09
Type IV: Kilfrost ABC-S Plus	HOT Testing: 2006-07	2008-09
Type IV: Lyondell ARCTIC Shield®	HOT Testing: 2006-07	2008-09
Type IV: Octagon Max-Flight	HOT Testing: 1996-97 (NS,ZR,ZD), 1997-98 (ZR,ZD,CS), 1998-99, 2000-01	2008-09
Type IV: Octagon Max-Flight 04	2000-01	2008-09
Type IV: Octagon MaxFlo	2004-05	2008-09

3.4 Formatting Changes

Several formatting changes were made to the holdover time guidelines for the winter of 2009-10. Corresponding changes were made to the regression coefficients publication. The changes are detailed in Table 3.2.

Table 3.2: Formatting Changes

#	Holdover Time Guidelines Change	Corresponding Regression Coefficients Publication Change
1.	Frost holdover times were moved from the generic and fluid-specific holdover time tables to a separate frost table (see Subsection 1.5).	The frost column was removed from the regression coefficients tables. As frost holdover times are not based on regression analysis, a regression coefficients table is not required for the frost holdover time table.
2.	The "below -25°C" row was removed from the Type II and Type IV HOT tables. In its place, the "below -14 to -25°C" row was modified to "below -14 to -25°C or LOUT".	The same changes were made to the corresponding regression coefficients tables.

3.5 Data Verification

In order to verify the accuracy of the data provided in the regression coefficients tables, the data provided in the tables was used to generate values for a fluid-specific holdover time table for each fluid. This information was cross-referenced with the values provided in the published generic and fluid-specific holdover time tables. The values were the same, which ensured that the regression coefficients were correct.

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4. REGRESSION COEFFICIENTS AND EQUATIONS

The regression coefficients and equations for the 2009-10 Transport Canada holdover time guidelines are provided online in the document "Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-10." A copy of the document is included in Appendix B. Additional explanatory information is provided in this chapter.

4.1 Table Format and Footnotes

Each regression coefficients table is presented in the format of its corresponding holdover time table. A footnote is provided at the top of each column to indicate the form of the regression equation for the cells in that column. The regression coefficients required for the equation are given in the corresponding cells below.

The coefficients provided in each table cell are valid only for the conditions (temperature, precipitation type, fluid dilution) of that cell. In cells where no temperature coefficient (coefficient "B") is provided, temperature is not an input in the equation. The regression coefficients are derived using the lowest temperature in the temperature range of the cell and must be used for all temperatures in the cell.

Additional footnotes are provided for several of the tables. Two sets of coefficients are provided in some table cells because different data sets are responsible for the upper and lower values in the cell (see Subsection 3.3). A footnote on these cells indicates that each set of regression coefficients must be used to calculate a holdover time and that the shortest holdover time calculated is the value that must be used.

Footnotes are also used to highlight discrepancies that may be encountered if the regression coefficients are used to calculate the values provided in the Transport Canada Holdover Time Guidelines.

As per the protocol described in Subsection 2.3.2, generic regression coefficients are included in the "below -14 to -25°C or LOUT" snow cell for all Type II and Type IV fluids except Dow UCAR Ultra+.

4.2 Regression Coefficients for 2009-10 Holdover Time Tables

A list of the regression coefficients tables provided for the 2009-10 holdover time tables is provided in Table 4.1 below in alphabetical order by fluid type.

Table 4.1: Regression Coefficients Tables for Winter 2009-10

Fluid Type	Regression Coefficients Tables
Type I	• Generic Type I
Type II	• ABAX Ecowing 26 • Aviation Shaanxi Hi-tech Cleanwing II • Clariant Safewing MP II 1951* • Clariant Safewing MP II 2025 ECO • Clariant Safewing MP II Flight • Kilfrost ABC-2000 • Kilfrost ABC-K Plus • Newave Aerochemical FCY-2 • Octagon E Max II • Type II "Grandfathered" Fluid Data*
Type III	• Clariant Safewing MP III 2031
Type IV	• ABAX AD-480 • ABAX Ecowing AD-49 • Clariant Safewing MP IV 2001 • Clariant Safewing MP IV 2012 Protect • Clariant Safewing MP IV Launch • Dow UCAR ADF/AAF Ultra+ • Dow UCAR Endurance EG106 • Dow UCAR FlightGuard AD-480 • Kilfrost ABC-4^{sustain} • Kilfrost ABC-S • Kilfrost ABC-S Plus • Lyondell ARCTIC Shield • Octagon Max-Flight • Octagon Max-Flight 04 • Octagon MaxFlo

* These tables can not be used to derive fluid-specific values for any fluid; they are only to be used in the calculation of generic Type II holdover times. See Subsection 3.2.2.2.

4.3 Data Limitations

There are several limitations of the regression coefficients and equations data that must be considered by users of the data.

4.3.1 Limitation #1: OAT Greater or Equal to 2°C

The regression equations which include a temperature coefficient cannot be populated with temperature data greater than or equal to 2°C. This is a limitation of the form of the equation.

4.3.2 Limitation #2: Non-Standard Fluid Dilutions

The data cannot be interpolated to determine holdover times for fluid dilutions other than the standard 100/0, 75/25 and 50/50 mixtures. This is due to the complex, non-linear, fluid-specific relationship between fluid dilution and holdover time.

4.3.3 Limitation #3: Precipitation Rates Outside Rate Limit Boundaries

Caution must be used when using the regression equations to calculate holdover times with precipitation rates outside of the precipitation rate limits used in the development of holdover time tables (see Subsection 2.2).

The regression coefficients are based on best-fit power-law curves and the shape of these curves can result in extreme values outside the precipitation rate limits at which endurance time tests are conducted. Caution must therefore be exercised in applying the regression coefficients at precipitation rates outside of the precipitation rate limits, especially at precipitation rates below the lower precipitation rate limit where the power-law curves give much longer holdover times.

This is illustrated in the sample regression shown in Figure 4.1. This example illustrates that at precipitation rates below the lower rate limit at which tests are conducted (5 g/dm^2/h in this example), derived holdover times can increase substantially with a small decrease in precipitation rate. For example: at the lower rate limit of 5 g/dm^2/h, the endurance time is approximately 82 minutes; at a slightly lower rate of 3 g/dm^2/h, the endurance time jumps to 122 minutes.

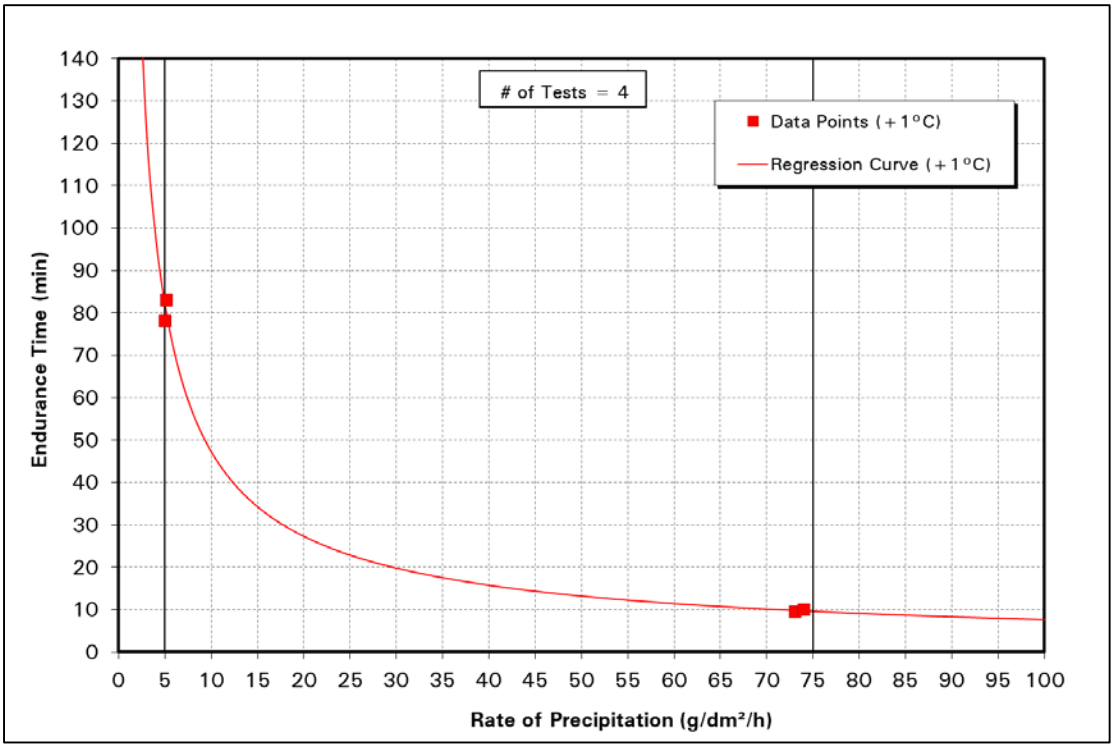

Figure 4.1: Sample Regression Curve – Cold-Soaked Wing

4.4 Data Verification Tables

Verification tables are included in the online regression coefficients document (Appendix B). The values in these tables were calculated using the regression coefficients provided in the online document. There is a verification table provided for each data set listed in Table 4.1.

Verification tables are also provided for the generic Type II and generic Type IV holdover time tables. The values in these tables were determined using the methodologies for calculating Type II and Type IV generic holdover times detailed in Subsections 2.4.2 and 2.4.4.

Each verification table provides holdover time values for the boundary conditions for each cell in the associated holdover time table. The verification tables can be used as an aid for the HOTDS manufacturers during the development process. These tables are not all encompassing and HOTDS manufacturers are cautioned that they must develop comprehensive verification and validation methods covering normal and exceptional conditions (e.g. values outside of the temperature range) to ensure the adequacy of their software algorithms.

5. CONCLUSIONS

The regression coefficients and equations required for the 2009-10 holdover time guidelines will be published online in January 2010 in a document entitled, "Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-10."

How and from where the data included in the online publication was obtained is documented in this report. The data was predominantly collected from the results of holdover time testing conducted from the winters of 1996-97 to 2008-09.

The regression coefficients and equations can be used as inputs in HOTDS, as required by the Transport Canada exemption to CAR 622.11, for the winter of 2009-10. However, users are cautioned that care must be taken in the application of the regression information. There are a number of rules, exceptions and cautions detailed in this report, in the online document and in the holdover time guidelines themselves that must be respected. It is also important to note that additional restrictions may be put on the usage of the data by regulators (for example by the Transport Canada exemption document).

Because the holdover time guidelines are updated on an annual basis and include changes such as the addition of newly qualified fluids, the removal of unavailable fluids and changes to the generic tables, the regression information must also be updated on an annual basis. That requires that both the online document and this report be updated.

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6. RECOMMENDATIONS

Due to the dynamic nature of the holdover time tables, it is recommended that the two regression information publications – the online document and this report – be updated and published on an annual basis.

As HOTDS progress, further analysis may become necessary and/or desired. Several recommendations to this end are provided in the Transport Canada report, TP 14873E, *Regression Coefficients and Equations Used to Develop the Winter 2008-09 Aircraft Ground Deicing Holdover Time Tables* (1).

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REFERENCES

1. Bendickson, S., *Regression Coefficients and Equations Used to Develop the Winter 2008-09 Aircraft Ground Deicing Holdover Time Tables*, APS Aviation Inc., Transportation Development Centre, Montreal, December 2008, TP 14873E, XX (to be published).

2. SAE International Aerospace Recommended Practice 5718, *Qualification Process for SAE AMS1428 Type II, III, and IV Fluids*, March 2008.

3. Bendickson, S., Campbell, R., Chaput, M., D'Avirro, J., Dawson, P., Mayodon, M., *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2002-03 Winter,* APS Aviation Inc., Transportation Development Centre, Montreal, December 2003, TP 14144E, XX (to be published).

4. Alwaid, A., Dawson, P., Moc, N., *Generation of Holdover Times Using the New Type I Fluid Test Protocol,* APS Aviation Inc., Transportation Development Centre, Montreal, December 2002, TP 13994E, 106.

5. Bendickson, S., *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2008-09 Winter*, APS Aviation Inc., Transportation Development Centre, Montreal, October 2009, TP 14933E, XX (to be published).

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APPENDIX A

TRANSPORTATION DEVLOPMENT CENTRE
WORK STATEMENT EXCERPT –
AIRCRAFT & ANTI-ICING FLUID
WINTER TESTING 2008-09

TRANSPORTATION DEVLOPMENT CENTRE
WORK STATEMENT EXCERPT –
AIRCRAFT & ANTI-ICING FLUID
WINTER TESTING 2008-09

4.7 RESEARCH INFORMATION DISSEMINATION

4.7.4 Update: Regression Coefficients Used to Develop Holdover Times

a) Discuss making potential modifications to the holdover time guidelines to address discrepancies between published holdover times and holdover times calculated using the published regressions coefficients;

b) Update regression coefficients tables and verification tables to reflect changes made to the holdover time guidelines for the winter 2009-10 operating season;

c) Prepare guidance material formatted similarly to the regression coefficients tables for ice pellet allowance times; and

d) Prepare a final report to document the applicable regression coefficients and verification tables required for the winter of 2009-10.

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APPENDIX B

TRANSPORT CANADA
HOLDOVER TIME (HOT) GUIDELINES
REGRESSION INFORMATION
WINTER 2009-10

Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-2010

Original Issue, January 2010

This document should be used in conjunction with the Transport Canada Holdover Time Guidelines, available at http://tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm.

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 the changes have been made on these pages.

It is the responsibility of the end user to periodically check the following website for updates on Regression Information: http://www.tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm.

REVISION	*DATE*	*DESCRIPTION OF CHANGES*	*AFFECTED PAGES*	*AUTHOR*

TC HOT Guidelines Regression Information **Winter 2009-2010**

SUMMARY OF CHANGES FROM PREVIOUS YEAR

As this is the first year this document is published, there are no changes from a previous year.

GUIDANCE FOR USING REGRESSION INFORMATION

In recent years, several companies have been developing systems that measure temperature, precipitation type and precipitation rate in real-time. These systems, referred to as holdover time determination systems (HOTDS), use the weather data they collect and the regression information underlying the holdover time guidelines to calculate more precise holdover times than can be obtained from the holdover time guidelines.

As a result of the development of HOTDS, Transport Canada is required to make the regression coefficients and equations underlying the holdover time tables available to users. The purpose of this document is to provide the holdover time guidelines regression information for the 2009-10 holdover time guidelines and to provide guidance on its usage.

The sources of the regression data, along with a history of the publication of regression information, are documented in the Transport Canada report, TP 14937E, *Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables*. This document can be referenced for further information if required.

At this time, operational approval for use of these systems is only authorized through the Transport Canada exemption process. The information contained in this report can only be used in conjunction with the applicable Transport Canada exemption. The applicable exemption document must be referred to for further information and guidance.

Interpreting Regression Coefficients Tables

Regression information is provided in this document in a series of regression coefficients tables. Each regression coefficients table shows the regression coefficients and equations that are to be used to calculate holdover times at specific outside air temperatures, under specific precipitation types, with specific fluid dilutions (as applicable for Type II/III/IV fluids).

Each regression coefficients table is presented in the format of its corresponding holdover time table. A footnote is provided at the top of each column to indicate the form of the regression equation for the cells in that column. The regression coefficients required for the equation are given in the corresponding cells below.

The coefficients provided in each table cell are valid only for the conditions (temperature, precipitation type, fluid dilution) of that cell. In cells where no temperature coefficient (coefficient "B") is provided, temperature is not an input into the equation.

Applicability of Regression Coefficients Tables

The Type I generic regression coefficients table is applicable for all Type I fluids. Fluid-specific regression coefficients tables are available and applicable for Type III fluids and the majority of Type II and Type IV fluids. If a fluid-specific table is not available for use in calculating fluid-specific holdover times for a Type II or Type IV fluid (currently the case for only two fluids – Clariant Safewing MP II 1951 and Kilfrost ABC-3) or if the specific fluid being used is not known, the methodology for calculating Type II or Type IV generic holdover times must be followed (see below).

Calculating Type II and Type IV Generic Holdover Times

Generic Type II and Type IV holdover times are used when a flight crew is unaware of the specific fluid that has been used to de/anti-ice their aircraft. The generic values represent the shortest

possible holdover time of either all Type II or all Type IV fluids available. The following methodologies must by applied to HOTDS programming to enable the systems to determine generic Type II and Type IV holdover times.

Type II: To calculate Type II generic holdover times, HOTDS must be programmed to return the shortest holdover time calculated from the regression information provided for each of the following:

a) Each Type II fluid on the list of qualified fluids, excluding Kilfrost ABC-3;

b) The grandfathered fluid data set, and

c) Each Type IV fluid on the list of qualified fluids (as Type IV fluids also qualify as Type II fluids).

This methodology must also be followed if either Kilfrost ABC-3 or Clariant Safewing MP II 1951 is being used, as neither of these fluids is qualified for use with fluid-specific holdover times.

Type IV: To calculate Type IV generic holdover times, HOTDS must be programmed to calculate the holdover time for each Type IV fluid on the list of qualified fluids and return the shortest holdover time calculated. This is the generic Type IV holdover time.

Verification Tables

Verification tables are provided for each of the regression coefficients tables. In addition, verification tables are provided for the generic Type II and generic Type IV holdover times. Each verification table provides holdover time values for the boundary conditions for each cell in the associated holdover time table.

NOTE: HOTDS manufacturers may find it useful to use these verification tables as an aid in verifying the implementation of their software algorithms. However, HOTDS manufacturers are cautioned that these tables are not all encompassing and that they must develop comprehensive verification and validation methods to ensure the adequacy of their software algorithms.

Limitations of Regression Information

Users are cautioned that care must be taken in the application of the regression information. There are a number of rules, exceptions and cautions detailed in both this document and in the holdover time guidelines that must be considered. It is also important to note that additional restrictions may be put on their usage by the applicable Transport Canada exemption document.

There are several limitations on the usage of the regression information:

- Regression equations which include a temperature coefficient can not be populated with temperature data greater than or equal to 2°C. This is a limitation of the form of the equation. At this time it is recommended that 0°C be input into HOTDS when temperature is above 0°C[1].
- Regression data is developed for specific fluid dilutions. The data can not be interpolated to determine holdover times for use with dilutions other than the standard 100/0, 75/25 and 50/50 mixtures.

[1] The issue of temperatures above 0°C will be addressed in future releases of the associated exemption document.

TC HOT Guidelines Regression Information **Winter 2009-2010**

- The regression coefficients are based on best-fit power-law curves and the shape of these curves can result in extreme values outside the precipitation rate limits at which endurance time tests are conducted. Therefore, these values are not necessarily accurate. Caution must therefore be exercised when using the regression equations to calculate holdover times outside of the precipitation rate limits used in the development of holdover time tables, especially at precipitation rates below the lower precipitation rate limit, where the power-law curves give much longer holdover times.

- As regression coefficients and equations are not currently used in the determination of frost holdover times, regression coefficient information is not provided for frost.

- As regression coefficients and equations are not used in the determination of the allowance times provided for ice pellets and ice pellets mixed with other types of precipitation, regression coefficient information is not provided for the ice pellet allowance times.

REGRESSION INFORMATION TABLES FOR WINTER 2009-2010

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 1-1

GENERIC TYPE I

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit	Freezing Fog[1]	Snow or Snow Grains[2,3]	Freezing Drizzle[1]	Light Freezing Rain[1,4]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	I = 1.3735 A = -0.4751	I = 2.0072 A = -0.5752 B = -0.5585	I = 1.3829 A = -0.3848	I = 1.4688 A = -0.6200	I = 0.9355 A = -0.3384	
below -3 to -6	below 27 to 21	I = 1.2734 A = -0.5299	I = 2.0072 A = -0.5752 B = -0.5585	I = 1.3842 A = -0.6152	I = 1.4688 A = -0.6200		
below -6 to -10	below 21 to 14	I = 1.1678 A = -0.5575	I = 2.0072 A = -0.5752 B = -0.5585	I = 1.2545 A = -0.5857	I = 2.2598 A = -1.4012		
below -10	below 14	I = 1.1473 A = -0.6415	I = 2.0072 A = -0.5752 B = -0.5585				CAUTION: No holdover time guidelines exist

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] Snow values in the Type I holdover time table are rounded DOWN to the nearest one minute (i.e. 6.2 mins = 6 mins, 5.9 mins = 5 mins) and therefore may differ slightly from the values calculated using these coefficients.

[4] These coefficients are valid for the Transport Canada table. For the FAA table, the "below -6 to -10" coefficients should also be used for "-3 and above" and "below -3 to -6".

Outside Air Temp. (°C)	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*[1]										
	Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)			Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
	5	2	25	10	4	13	5	25	13	75	5
-3	11.0	17.0	6.5	11.0	18.6	9.0	13.0	4.0	6.0	2.0	5.0
-6	8.0	13.0	5.0	8.5	14.3	5.0	9.0	4.0	6.0		
-10	6.0	10.0	4.0	6.7	11.4	4.0	7.0	2.0	5.0		
-25	5.0	9.0	2.5	4.3	7.3						

[1] These coefficients are valid for the Transport Canada table. The values will be different if the coefficients for the FAA guidelines are applied.

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-1

ABAX ECOWING 26

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.3810 A = -0.6352	I = 2.3598 A = -0.5098 B = -0.0978	I = 2.4589 A = -0.6723	I = 2.0131 A = -0.2946	I = 2.3224 A = -0.5535	
		75/25	I = 2.2439 A = -0.6073	I = 2.3485 A = -0.6016 B = -0.1043	I = 2.1009 A = -0.4085	I = 2.0488 A = -0.4806	I = 2.2032 A = -0.6072	
		50/50	I = 1.7955 A = -0.5090	I = 2.0178 A = -0.6943 B = 0.0298	I = 1.7327 A = -0.5413	I = 1.6166 A = -0.5058		
below -3 to -14	below 27 to 7	100/0	I = 2.5006 A = -1.2335	I = 2.3598 A = -0.5098 B = -0.0978	I = 2.4044 A = -0.8101	I = 2.7587 A = -1.1217	CAUTION: No holdover time guidelines exist	
		75/25	I = 2.1380 A = -0.8452	I = 2.3485 A = -0.6016 B = -0.1043	I = 2.2768 A = -0.8445	I = 2.3760 A = -0.8759		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8682 A = -0.6972	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	86.5	154.8	37.9	60.5	51.3	97.5	39.9	48.4	19.3	86.2
	75/25	66.0	115.1	27.2	47.2	44.2	65.4	23.8	32.6	11.6	60.1
	50/50	27.5	43.9	11.7	22.1	13.5	22.6	8.1	11.3		
-10 / -14 **	100/0	43.5	134.7	33.8	54.0	31.8	68.9	15.5	32.3		
	75/25	35.3	76.5	24.1	41.8	21.7	48.6	14.2	25.1		
-25	100/0	24.0	45.5	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-2

AVIATION SHAANXI HI-TECH CLEANWING II

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.2573 A = -0.7407	I = 2.4007 A = -0.6714 B = 0.0000	I = 2.1979 A = -0.5728	I = 2.2567 A = -0.6317	I = 2.1512 A = -0.6064	
		75/25	I = 2.0742 A = -0.5411	I = 2.3510 A = -0.6986 B = 0.0000	I = 2.1475 A = -0.5338	I = 2.2158 A = -0.6683	I = 2.1568 A = -0.6861	
		50/50	I = 1.9836 A = -0.6276	I = 2.3242 A = -0.6725 B = -0.2889	I = 2.0341 A = -0.6288	I = 2.1847 A = -0.7830		
below -3 to -14	below 27 to 7	100/0	I = 2.3283 A = -0.9431	I = 2.4007 A = -0.6714 B = 0.0000	I = 2.1441 A = -0.6033	I = 1.8282 A = -0.4021		CAUTION: No holdover time guidelines exist
		75/25	I = 2.3328 A = -1.0611	I = 2.3510 A = -0.6986 B = 0.0000	I = 1.6685 A = -0.1061	I = 1.7474 A = -0.3274		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9950 A = -0.9540	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	54.9	108.2	29.0	53.6	36.3	62.7	23.6	35.7	10.3	53.4
	75/25	49.7	81.5	23.7	44.9	35.7	59.5	19.1	29.6	7.4	47.6
	50/50	35.1	62.3	15.2	28.2	21.6	39.3	12.3	20.5		
-10 / -14 **	100/0	46.7	110.8	29.0	53.6	29.7	52.8	18.5	24.0		
	75/25	39.0	103.1	23.7	44.9	35.5	39.3	19.5	24.1		
-25	100/0	21.3	51.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-3

CLARIANT SAFEWING MP II 1951

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions[1]					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[2]	Snow or Snow Grains[3]	Freezing Drizzle[2]	Light Freezing Rain[2]	Rain on Cold Soaked Wing[2]	Other
-3 and above	27 and above	100/0	I = 2.1983 A = -0.6306	I = 2.4921 A = -0.7197 B = -0.1457	I = 2.1302 A = -0.5579	I = 2.0690 A = -0.5228	I = 2.1024 A = -0.5666	
		75/25	I = 2.0535 A = -0.5710	I = 2.4196 A = -0.7591 B = -0.1914	I = 2.0792 A = -0.6250	I = 1.9155 A = -0.5042	I = 2.0174 A = -0.6000	
		50/50	I = 1.5607 A = -0.3896	I = 2.3542 A = -0.9691 B = -0.3207	I = 1.6283 A = -0.6320	I = 1.6164 A = -0.5744		
below -3 to -14	below 27 to 7	100/0	I = 2.1272 A = -0.6673	I = 2.4921 A = -0.7197 B = -0.1457	I = 2.1765 A = -0.6919	I = 2.3569 A = -0.8074		CAUTION: No holdover time guidelines exist
		75/25	I = 1.9549 A = -0.6133	I = 2.4196 A = -0.7591 B = -0.1914	I = 1.9187 A = -0.5179	I = 1.9149 A = -0.5296		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8859 A = -0.8776	I = 2.2336 A = -0.7565 B = 0.0000				

[1] The Clariant Safewing MP II 1951 regression information is only to be used in the calculation of Type II generic holdover times. The information can not be used to deduce fluid-specific holdover times for Clariant Safewing MP II 1951.

[2] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[3] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	57.2	102.0	24.2	46.8	32.3	55.0	21.8	30.7	11.0	50.9
	75/25	45.1	76.1	16.8	33.6	24.2	43.9	16.2	22.6	7.8	39.6
	50/50	19.4	27.8	6.0	14.5	8.4	15.4	6.5	9.5		
-10 / -14 **	100/0	45.8	84.4	20.4	39.5	25.5	49.3	16.9	28.7		
	75/25	33.6	58.9	13.4	26.9	22.0	36.0	14.9	21.1		
-25	100/0	18.7	41.9	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-4

CLARIANT SAFEWING MP II 2025 ECO

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1,3]	Light Freezing Rain[1,3]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.2170 A = -0.3761	I = 2.5814 A = -0.6515 B = -0.1227	I = 2.0815 A = -0.4337	I = 1.9352 A = -0.3644	I = 2.3766 A = -0.6988	
		75/25	I = 2.2154 A = -0.6580	I = 2.3101 A = -0.6381 B = -0.0207	I = 2.0114 A = -0.5227	I = 2.0417 A = -0.5535	I = 2.1628 A = -0.6547	
		50/50	I = 1.7239 A = -0.5878	I = 1.9823 A = -0.6443 B = -0.1369	I = 1.6305 A = -0.5588	I = 1.6662 A = -0.5666		
below -3 to -14	below 27 to 7	100/0	I = 2.3481 A = -1.0089	I = 2.5814 A = -0.6515 B = -0.1227	I = 2.3325 A = -0.7221	I = 2.3161 A = -0.7245		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1350 A = -0.7781	I = 2.3101 A = -0.6381 B = -0.0207	I = 1.8741 A = -0.3913	I = 1.9634 A = -0.5459		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8729 A = -0.6740	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

[3] Freezing drizzle and light freezing rain values were calculated at 12.7 g/dm^2/h the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 g/dm^2/h, values in the holdover time table may differ slightly from those calculated using these coefficients.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	90.0	127.0	38.4	69.8	39.7	60.0	26.7	33.8	11.6	77.3
	75/25	56.9	104.1	25.3	45.4	26.9	44.3	18.5	26.6	8.6	50.7
	50/50	20.6	35.2	9.7	17.5	10.2	17.4	7.5	10.8		
-10 / -14 **	100/0	43.9	110.8	33.3	60.6	33.7	67.3	20.1	32.3		
	75/25	39.0	79.6	24.7	44.4	27.4	39.9	15.9	22.7		
-25	100/0	25.2	46.8	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-5

CLARIANT SAFEWING MP II FLIGHT

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4369 A = -0.1630	I = 2.7425 A = -0.5435 B = -0.3120	I = 2.6541 A = -0.6697	I = 2.9080 A = -0.8860	I = 2.4810 A = -0.7583	
		75/25	I = 2.5510 A = -0.5352	I = 3.0163 A = -0.7162 B = -0.5615	I = 2.5845 A = -0.6398	I = 2.6717 A = -0.8305	I = 2.5884 A = -0.9638	
		50/50	I = 2.2250 A = -0.6732	I = 2.2879 A = -0.7080 B = -0.2971	I = 1.7413 A = -0.3693	I = 1.9070 A = -0.6463		
below -3 to -14	below 27 to 7	100/0	I = 2.2233 A = -0.6827	I = 2.7425 A = -0.5435 B = -0.3120	I = 2.6220 A = -0.9557	I = 2.5701 A = -0.8095		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0461 A = -0.6512	I = 3.0163 A = -0.7162 B = -0.5615	I = 2.6085 A = -1.0800	I = 2.2911 A = -0.5972		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8996 A = -0.6356	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	210.4	244.2	58.2	95.7	80.9	153.5	46.7	83.4	11.5	89.3
	75/25	150.3	245.4	41.9	80.8	74.4	137.2	32.4	55.8	6.0	82.2
	50/50	56.8	105.3	12.3	23.6	21.4	30.4	10.1	15.4		
-10 / -14 **	100/0	55.7	104.2	40.5	66.6	36.1	89.9	27.4	46.6		
	75/25	39.0	70.8	21.8	42.1	25.4	71.4	28.6	42.3		
-25	100/0	28.5	51.1	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-6

KILFROST ABC-2000

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5017 A = -0.7918	I = 2.6793 A = -0.7155 B = -0.2475	I = 2.3530 A = -0.5406	I = 2.1752 A = -0.4212	I = 2.2715 A = -0.6219	
		75/25	I = 2.5693 A = -0.8090	I = 2.6945 A = -0.7473 B = -0.2060	I = 2.2641 A = -0.5653	I = 2.0107 A = -0.2793	I = 2.5276 A = -0.7483	
		50/50	I = 2.3546 A = -0.8144	I = 2.3633 A = -0.8758 B = 0.0000	I = 1.7696 A = -0.5811	I = 1.8264 A = -0.6348		
below -3 to -14	below 27 to 7	100/0	I = 2.1872 A = -0.8952	I = 2.6793 A = -0.7155 B = -0.2475	I = 2.2482 A = -0.7642	I = 2.8779 A = -1.2797		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1388 A = -0.8953	I = 2.6945 A = -0.7473 B = -0.2060	I = 2.2588 A = -0.7609	I = 2.5694 A = -0.9881		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9361 A = -0.8977	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	88.8	183.4	32.1	61.8	56.3	94.4	38.6	50.8	12.7	68.7
	75/25	100.9	211.7	32.1	63.6	43.1	74.0	41.7	50.1	13.3	101.1
	50/50	61.0	128.7	13.8	30.7	13.3	23.1	8.7	13.2		
-10 / -14 **	100/0	36.4	82.7	24.0	46.3	24.9	51.8	12.3	28.3		
	75/25	32.6	74.0	25.2	50.0	25.8	53.3	15.4	29.4		
-25	100/0	20.4	46.3	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-7

KILFROST ABC-K PLUS

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5148 A = -0.5532	I = 2.6804 A = -0.5771 B = -0.1414	I = 2.2527 A = -0.1978	I = 2.5473 A = -0.5588	I = 2.6523 A = -0.7393	
		75/25	I = 2.3020 A = -0.4342	I = 2.5273 A = -0.6849 B = -0.0149	I = 2.3200 A = -0.3522	I = 2.4709 A = -0.5601	I = 2.5956 A = -0.7470	
		50/50	I = 1.9950 A = -0.6463	I = 2.3972 A = -0.8261 B = -0.5288	I = 1.7256 A = -0.3910	I = 2.0364 A = -0.7354		
below -3 to -14	below 27 to 7	100/0	I = 2.0780 A = -0.8928	I = 2.6804 A = -0.5771 B = -0.1414	I = 2.4865 A = -0.9979	I = 3.2510 A = -1.5260		CAUTION: No holdover time guidelines exist
		75/25	I = 2.3405 A = -1.3357	I = 2.5273 A = -0.6849 B = -0.0149	I = 2.4921 A = -1.0863	I = 3.6906 A = -1.9574		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9498 A = -0.6590	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	134.3	223.0	59.5	101.0	107.7	130.1	58.4	84.1	18.5	136.6
	75/25	99.7	148.4	36.3	67.9	84.7	118.5	48.7	70.3	15.7	118.4
	50/50	34.9	63.2	7.5	15.9	19.5	28.3	10.2	16.5		
-10 / -14 **	100/0	28.4	64.5	50.5	85.7	23.7	61.5	13.1	35.6		
	75/25	25.5	86.8	35.6	66.8	19.1	54.1	9.0	32.4		
-25	100/0	30.8	56.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-8

NEWAVE FCY-2

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.3831 A = -0.7394	I = 2.7862 A = -0.6652 B = -0.5351	I = 2.3424 A = -0.7349	I = 2.1756 A = -0.5685	I = 2.0886 A = -0.6241	
		75/25	I = 2.1617 A = -0.6765	I = 2.6255 A = -0.6413 B = -0.5531	I = 2.1241 A = -0.6856	I = 2.6154 A = -1.0787	I = 1.8312 A = -0.6039	
		50/50	I = 1.6808 A = -0.3883	I = 2.1561 A = -0.7445 B = 0.0000	I = 1.7656 A = -0.6698	I = 1.6020 A = -0.5128		
below -3 to -14	below 27 to 7	100/0	I = 2.1844 A = -0.7552	I = 2.7862 A = -0.6652 B = -0.5351	I = 2.2637 A = -0.8968	I = 1.6935 A = -0.3738		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0300 A = -0.7545	I = 2.6255 A = -0.6413 B = -0.5531	I = 2.0031 A = -0.7745	I = 2.0994 A = -0.8524		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.7388 A = -0.5485	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	73.5	144.7	30.4	55.8	33.4	67.4	24.0	34.9	8.3	44.9
	75/25	48.8	90.8	22.0	39.6	22.9	44.1	12.8	25.9	5.0	25.7
	50/50	25.7	36.6	13.0	25.8	10.5	19.8	7.7	10.7		
-10 / -14 **	100/0	45.3	90.6	16.3	30.0	18.4	43.3	14.8	18.9		
	75/25	31.8	63.5	11.6	20.8	13.8	29.0	8.1	14.1		
-25	100/0	22.7	37.5	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-9

OCTAGON E MAX II

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1,3]	Light Freezing Rain[1,4]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5459 A = -0.6373	I = 2.6668 A = -0.6858 B = -0.1217	I = 2.5718 A = -0.8425	I = 2.2283 A = -0.5498	I = 2.4284 A = -0.6853	
		75/25	I = 2.4583 A = -0.7527	I = 2.6369 A = -0.8175 B = -0.1119	I = 2.2245 A = -0.5480	I = 2.0418 A = -0.4936	I = 2.3114 A = -0.7004	
		50/50	I = 1.9264 A = -0.6775	I = 2.3965 A = -0.9103 B = -0.0736	I = 1.9337 A = -0.7031	I = 1.6119 A = -0.4530		
below -3 to -14	below 27 to 7	100/0	I = 2.2755 A = -0.8543	I = 2.6668 A = -0.6858 B = -0.1217	I = 2.2209 A = -0.6158	I = 2.2141 A = -0.6418		CAUTION: No holdover time guidelines exist
		75/25	I = 2.2071 A = -0.9994	I = 2.6369 A = -0.8175 B = -0.1119	I = 2.3457 A = -0.7362	I = 2.4525 A = -0.8693		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.7407 A = -0.6333	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

[3] The upper value in the "below -3 to -14", 75/25 freezing drizzle cell is 67.8 mins. Due to a rounding error, the value in the holdover time table is 65 mins.

[4] The lower value in the "-3 and above", 50/50, freezing rain cell is 9.5 mins. This is rounded to 10 mins in the HOT table, but protocol dictates it should be rounded to 5 mins.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	126.0	226.0	42.0	78.7	43.0	96.1	28.8	41.3	13.9	89.0
	75/25	85.5	170.5	26.1	55.1	41.1	69.4	22.5	31.0	10.0	66.4
	50/50	28.4	52.8	11.8	27.2	14.1	27.7	9.5	12.8		
-10 / -14 **	100/0	47.7	104.3	36.4	68.3	34.3	61.7	20.7	31.6		
	75/25	32.3	80.6	22.9	48.4	33.5	67.8	17.3	30.5		
-25	100/0	19.9	35.5	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 2-10

TYPE II "GRANDFATHERED" FLUID DATA

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions[1]					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[2]	Snow or Snow Grains[2]	Freezing Drizzle[2]	Light Freezing Rain[2]	Rain on Cold Soaked Wing[2]	Other
-3 and above	27 and above	100/0	I = 2.2645 A = -1.0307	I = 2.5382 A = -0.8850	I = 2.2851 A = -0.7254	I = 2.6578 A = -1.0599	I = 1.9599 A = -0.5119	
		75/25	I = 2.0657 A = -0.9554	I = 2.2336 A = -0.7565 B =	I = 2.2464 A = -0.8486	I = 2.9588 A = -1.4012	I = 1.8133 A = -0.5943	
		50/50	I = 2.0141 A = -1.1989	I = 2.3751 A = -1.1990	I = 1.8080 A = -0.7254	I = 2.1807 A = -1.0599		
below -3 to -14	below 27 to 7	100/0	I = 2.2645 A = -1.0307	I = 2.6725 A = -1.0704	I = 2.2851 A = -0.7254	I = 3.3485 A = -1.6800		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0657 A = -0.9554	I = 2.2336 A = -0.7565	I = 2.2464 A = -0.8486	I = 2.9588 A = -1.4012		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 2.4483 A = -1.6414	I = 2.2336 A = -0.7565				

[1] The Grandfather fluid regression information is only to be used in the calculation of Type II generic holdover times. The information can not be used to deduce fluid-specific holdover times for any fluid.

[2] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	35.0	90.0	20.0	45.0	30.0	60.0	15.0	30.0	10.0	40.0
	75/25	25.0	60.0	15.0	30.0	20.0	45.0	10.0	25.0	5.0	25.0
	50/50	15.0	45.0	5.0	15.0	10.0	20.0	5.0	10.0		
-10 / -14 **	100/0	35.0	90.0	15.0	40.0	30.0	60.0	10.0	30.0		
	75/25	25.0	60.0	15.0	30.0	20.0	45.0	10.0	25.0		
-25	100/0	20.0	90.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TABLE 2-11

TYPE II GENERIC

VERIFICATION TABLE

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	35.0	90.0	20.0	45.0	30.0	55.0	15.0	30.0	8.3	40.0
	75/25	25.0	60.0	15.0	30.0	20.0	43.9	10.0	22.6	5.0	25.0
	50/50	15.0	27.8	5.0	14.5	8.4	15.4	5.0	9.5		
-10 / -14 **	100/0	19.0	64.5	15.0	30.0	18.4	43.3	10.0	18.9		
	75/25	24.5	51.9	11.6	20.8	13.8	29.0	8.1	14.1		
-25	100/0	17.4	35.5	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C
**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 3-1

CLARIANT SAFEWING MP III 2031

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 1.8574 A = -0.6489	I = 2.1115 A = -0.6963 B = -0.1456	I = 1.9299 A = -0.7118	I = 1.7185 A = -0.5394	I = 1.7197 A = -0.4605	
		75/25	I = 1.7259 A = -0.6144	I = 1.9882 A = -0.6441 B = -0.1563	I = 1.7700 A = -0.6803	I = 1.8560 A = -0.7070	I = 1.5307 A = -0.5484	
		50/50	I = 1.5142 A = -0.6078	I = 1.7655 A = -0.6226 B = -0.2590	I = 1.3637 A = -0.5187	I = 1.4971 A = -0.5838		
below -3 to -10	below 27 to 14	100/0	I = 1.7495 A = -0.4928	I = 2.1115 A = -0.6963 B = -0.1456	I = 1.7755 A = -0.5900	I = 1.6118 A = -0.4205		CAUTION: No holdover time guidelines exist
		75/25	I = 1.7409 A = -0.7580	I = 1.9882 A = -0.6441 B = -0.1563	I = 1.3372 A = -0.2919	I = 1.6085 A = -0.5431		
below -10	below 14	100/0	I = 1.8547 A = -0.6749	I = 2.1115 A = -0.6963 B = -0.1456				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*										
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)			Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	4	13	5	25	13	75	5
+1 / -3 *	100/0	25.3	45.9	10.9	20.6	39.0	13.7	27.1	9.2	13.1	7.2	25.0
	75/25	19.8	34.7	9.5	17.2	31.0	10.3	19.7	7.4	11.7	3.2	14.0
	50/50	12.3	21.4	5.2	9.2	16.2	6.1	10.0	4.8	7.0		
-10	100/0	25.4	39.9	9.6	18.1	34.3	13.1	23.1	10.6	13.9		
	75/25	16.3	32.6	8.3	15.0	27.0	10.3	13.6	7.1	10.1		
-25	100/0	24.2	44.8	8.5	16.1	30.5						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-1

ABAX AD-480

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2,3]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5155 A = -0.6296	I = 2.8771 A = -0.7459 B = -0.3169	I = 2.4133 A = -0.6465	I = 2.3229 A = -0.5386	I = 2.5009 A = -0.7370	
		75/25	I = 2.4258 A = -0.6912	I = 2.8157 A = -0.8148 B = -0.2892	I = 2.2256 A = -0.4857	I = 2.2663 A = -0.5461	I = 2.3778 A = -0.7322	
		50/50	I = 1.7682 A = -0.3911	I = 2.4274 A = -0.8852 B = -0.2983	I = 1.8484 A = -0.6021	I = 1.7714 A = -0.5857		
below -3 to -14	below 27 to 7	100/0	I = 2.3324 A = -1.4027	I = 2.8771 A = -0.7459 B = -0.3169	I = 2.7690 A = -1.2527	I = 2.2782 A = -0.7465		CAUTION: No holdover time guidelines exist
		75/25	I = 1.9626 A = -0.8214	I = 2.8157 A = -0.8148 B = -0.2892	I = 2.5153 A = -1.0108	I = 2.4335 A = -0.8683		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8643 A = -0.8914	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] The lower value in "-3 and above", 50/50, snow is 9.6 minutes. This is rounded to 10 minutes in the HOT table, but protocol dictates it should be rounded to 5 minutes.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	119.0	211.8	41.0	81.2	49.3	91.5	37.2	52.8	13.2	96.8
	75/25	87.6	165.1	29.8	62.9	48.4	76.9	31.8	45.5	10.1	73.5
	50/50	31.2	44.7	9.6	21.6	15.1	26.8	9.0	13.2		
-10 / -14 **	100/0	22.5	81.3	28.4	56.2	23.6	78.2	17.2	28.0		
	75/25	24.5	51.9	21.3	44.9	24.5	64.4	16.6	29.3		
-25	100/0	17.4	39.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-2

ABAX ECOWING AD-49

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4713 A = -0.2370	I = 2.5108 A = -0.4746 B = 0.0000	I = 2.3729 A = -0.3927	I = 2.4943 A = -0.5000	I = 2.6531 A = -0.8558	
		75/25	I = 2.5800 A = -0.6022	I = 2.2550 A = -0.2574 B = 0.0000	I = 2.1714 A = -0.1070	I = 2.9993 A = -0.9367	I = 2.5561 A = -0.8097	
		50/50	I = 1.9283 A = -0.7029	I = 2.0082 A = -0.5107 B = -0.1529	I = 2.0190 A = -0.7545	I = 1.5732 A = -0.3413		
below -3 to -14	below 27 to 7	100/0	I = 2.5177 A = -1.7715	I = 2.5108 A = -0.4746 B = 0.0000	I = 2.8172 A = -1.2681	I = 1.9828 A = -0.5016		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1600 A = -1.0180	I = 2.2550 A = -0.2574 B = 0.0000	I = 2.7575 A = -1.3630	I = 2.3495 A = -0.8598		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.7838 A = -0.5976	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	202.1	251.2	70.4	108.7	86.2	125.4	62.4	86.6	11.2	113.5
	75/25	144.2	250.4	78.6	99.4	112.8	124.9	49.0	90.3	10.9	97.8
	50/50	27.4	52.1	15.4	24.6	15.1	31.0	12.5	15.6		
-10 / -14 **	100/0	19.0	96.5	70.4	108.7	25.4	85.3	19.1	26.5		
	75/25	28.1	71.4	78.6	99.4	17.3	63.8	14.0	24.6		
-25	100/0	23.2	40.2	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-3

CLARIANT SAFEWING MP IV 2001

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2,3]	Freezing Drizzle[1]	Light Freezing Rain[1,4]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5974 A = -0.9950	I = 3.2166 A = -0.6746 B = -0.6934	I = 2.6152 A = -0.7861	I = 2.3028 A = -0.4885	I = 2.9330 A = -0.9192	
		75/25	I = 2.2129 A = -0.4268	I = 2.6088 A = -0.5463 B = -0.4332	I = 2.2946 A = -0.6552	I = 2.0960 A = -0.5183	I = 2.4682 A = -0.7776	
		50/50	I = 1.8446 A = -0.8754	I = 1.9195 A = -0.6775 B = 0.0446	I = 1.8109 A = -0.6826	I = 1.9408 A = -0.7410		
below -3 to -14	below 27 to 7	100/0	I = 2.2514 A = -0.8912	I = 3.2166 A = -0.6746 B = -0.6934	I = 2.4071 A = -0.6057	I = 2.3361 A = -0.6177		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0040 A = -0.7493	I = 2.6088 A = -0.5463 B = -0.4332	I = 2.3116 A = -0.6459	I = 2.2208 A = -0.6513		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9535 A = -0.9662	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] The lower value in the "below -3 to -14", 100/0, snow cell is 27.45 minutes. Due to a rounding error, the value in the holdover time table is 30 minutes.

[4] Freezing drizzle and light freezing rain values were calculated at 12.7 $g/dm^2/h$ the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 $g/dm^2/h$, values in the holdover time table may differ slightly from those calculated using these coefficients.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	79.8	198.6	61.5	114.1	54.9	116.3	41.7	57.4	16.2	195.2
	75/25	82.1	121.5	34.9	57.5	36.7	68.6	23.5	33.0	10.2	84.1
	50/50	17.1	38.1	10.1	18.8	11.2	21.6	8.0	13.0		
-10 / -14 **	100/0	42.5	96.2	27.5	50.9	54.0	96.3	29.7	44.5		
	75/25	30.2	60.0	21.1	34.7	39.1	72.5	20.4	31.3		
-25	100/0	19.0	46.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-4

CLARIANT SAFEWING MP IV 2012 PROTECT

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4162 A = -0.7740	I = 2.9261 A = -0.6725 B = -0.5399	I = 2.2617 A = -0.6058	I = 2.6728 A = -0.9024	I = 2.2260 A = -0.6133	
		75/25	I = 2.2814 A = -0.6038	I = 2.7240 A = -0.7768 B = -0.3020	I = 2.0140 A = -0.4253	I = 2.3105 A = -0.7659	I = 2.0789 A = -0.6561	
		50/50	I = 1.8790 A = -0.7412	I = 1.9610 A = -0.6065 B = 0.0080	I = 1.5838 A = -0.3913	I = 1.7499 A = -0.6403		
below -3 to -14	below 27 to 7	100/0	I = 2.3070 A = -0.9577	I = 2.9261 A = -0.6725 B = -0.5399	I = 2.0559 A = -0.5619	I = 2.1217 A = -0.6374		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1045 A = -1.0145	I = 2.7240 A = -0.7768 B = -0.3020	I = 2.0469 A = -0.8034	I = 2.1825 A = -0.8178		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8720 A = -0.7608	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^I R^A (2\text{-}T)^B$, where R = rate (g/dm^2/h) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	75.0	152.5	40.6	75.2	38.6	68.9	25.8	46.5	11.9	62.7
	75/25	72.3	125.8	26.7	54.5	34.7	52.1	17.4	28.7	7.1	41.7
	50/50	23.0	45.3	13.1	22.9	14.1	20.4	7.2	10.9		
-10 / -14 **	100/0	43.4	104.4	21.7	40.1	26.9	46.0	17.0	25.8		
	75/25	24.9	63.0	18.8	38.3	14.2	30.6	10.9	18.7		
-25	100/0	21.9	44.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-5

CLARIANT SAFEWING MP IV LAUNCH

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.3942 A = 0.0152	I = 2.7218 A = -0.5330 B = -0.2408	I = 2.7789 A = -0.7426	I = 2.9492 A = -0.8489	I = 2.5170 A = -0.7291	
		75/25	I = 2.4388 A = -0.1431	I = 2.7841 A = -0.6180 B = -0.2044	I = 2.7945 A = -0.7101	I = 2.7548 A = -0.7917	I = 2.6192 A = -0.8499	
		50/50	I = 2.4323 A = -0.7333	I = 2.3978 A = -0.6703 B = -0.1021	I = 2.0818 A = -0.5727	I = 1.7686 A = -0.3607		
below -3 to -14	below 27 to 7	100/0	I = 2.2823 A = -0.7333	I = 2.7218 A = -0.5330 B = -0.2408	I = 2.7424 A = -1.0767	I = 2.6379 A = -0.8846		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1203 A = -0.7220	I = 2.7841 A = -0.6180 B = -0.2044	I = 2.6204 A = -1.0940	I = 2.4901 A = -0.7708		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8894 A = -0.6349	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	254.0	250.5	64.3	104.8	89.5	181.9	57.9	100.8	14.1	101.7
	75/25	218.2	248.7	59.9	105.5	100.8	198.7	44.5	74.6	10.6	106.0
	50/50	83.1	162.8	24.5	45.3	27.8	48.0	18.4	23.3		
-10 / -14 **	100/0	58.8	115.2	48.6	79.2	34.9	97.7	25.2	44.9		
	75/25	41.3	80.0	47.2	83.2	25.2	71.7	25.9	42.8		
-25	100/0	27.9	49.9	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-6

DOW UCAR ADF/AAF ULTRA+

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5966 A = -0.8735	I = 2.8804 A = -0.7939 B = -0.3039	I = 2.5269 A = -0.7811	I = 2.2847 A = -0.6144	I = 2.4056 A = -0.7072	
		75/25	n/a	n/a	n/a	n/a	n/a	
		50/50	n/a	n/a	n/a	n/a		
below -3 to -14	below 27 to 7	100/0	I = 2.4990 A = -0.8182	I = 2.8804 A = -0.7939 B = -0.3039	I = 2.4562 A = -0.7408	I = 2.4117 A = -0.6918		CAUTION: No holdover time guidelines exist
		75/25	n/a	n/a	n/a	n/a		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 2.4726 A = -1.2125	I = 2.8804 A = -0.7939 B = -0.3039				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	96.8	215.6	36.2	74.8	45.4	95.7	26.7	39.8	12.0	81.5
	75/25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	50/50	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
-10 / -14 **	100/0	84.5	178.9	25.4	52.5	42.8	86.8	27.8	43.8		
	75/25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
-25	100/0	42.2	128.1	21.7	44.8						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-7

DOW UCAR ENDURANCE EG106

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4198 A = -0.4664	I = 2.8358 A = -0.7951 B = -0.1996	I = 2.4460 A = -0.5295	I = 2.5011 A = -0.5672	I = 2.5903 A = -0.7102	
		75/25	n/a	n/a	n/a	n/a	n/a	
		50/50	n/a	n/a	n/a	n/a		
below -3 to -14	below 27 to 7	100/0	I = 2.4942 A = -0.6588	I = 2.8358 A = -0.7951 B = -0.1996	I = 2.5065 A = -0.6779	I = 2.6525 A = -0.7145		CAUTION: No holdover time guidelines exist
		75/25	n/a	n/a	n/a	n/a		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 2.0589 A = -0.7941	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	124.1	190.3	38.4	79.6	71.8	119.1	51.1	74.0	18.1	124.1
	75/25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	50/50	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
-10 / -14 **	100/0	108.1	197.6	30.5	63.1	56.4	107.8	45.0	71.9		
	75/25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
-25	100/0	31.9	66.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TABLE 4-8

DOW UCAR FLIGHTGUARD AD-480

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2,3]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5155 A = -0.6296	I = 2.8771 A = -0.7459 B = -0.3169	I = 2.4133 A = -0.6465	I = 2.3229 A = -0.5386	I = 2.5009 A = -0.7370	
		75/25	I = 2.4258 A = -0.6912	I = 2.8157 A = -0.8148 B = -0.2892	I = 2.2256 A = -0.4857	I = 2.2663 A = -0.5461	I = 2.3778 A = -0.7322	
		50/50	I = 1.7682 A = -0.3911	I = 2.4274 A = -0.8852 B = -0.2983	I = 1.8484 A = -0.6021	I = 1.7714 A = -0.5857		
below -3 to -14	below 27 to 7	100/0	I = 2.3324 A = -1.4027	I = 2.8771 A = -0.7459 B = -0.3169	I = 2.7690 A = -1.2527	I = 2.2782 A = -0.7465		CAUTION: No holdover time guidelines exist
		75/25	I = 1.9626 A = -0.8214	I = 2.8157 A = -0.8148 B = -0.2892	I = 2.5153 A = -1.0108	I = 2.4335 A = -0.8683		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8643 A = -0.8914	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] The lower value in "-3 and above", 50/50, snow is 9.6 minutes. This is rounded to 10 minutes in the HOT table, but protocol dictates it should be rounded to 5 minutes.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	119.0	211.8	41.0	81.2	49.3	91.5	37.2	52.8	13.2	96.8
	75/25	87.6	165.1	29.8	62.9	48.4	76.9	31.8	45.5	10.1	73.5
	50/50	31.2	44.7	9.6	21.6	15.1	26.8	9.0	13.2		
-10 / -14 **	100/0	22.5	81.3	28.4	56.2	23.6	78.2	17.2	28.0		
	75/25	24.5	51.9	21.3	44.9	24.5	64.4	16.6	29.3		
-25	100/0	17.4	39.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-9

KILFROST ABC-4[SUSTAIN]

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.6281 A = -0.8545	I = 2.6424 A = -0.6150 B = 0.0000	I = 2.2833 A = -0.2660	I = 2.5376 A = -0.5180	I = 2.5944 A = -0.6875	
		75/25	I = 2.2675 A = -0.7226	I = 2.2806 A = -0.5521 B = 0.0000	I = 2.1504 A = -0.4811	I = 2.3054 A = -0.6216	I = 2.4301 A = -0.7374	
		50/50	I = 1.7671 A = -0.7220	I = 2.0691 A = -0.8105 B = -0.0552	I = 1.8057 A = -0.7011	I = 1.8277 A = -0.7026		
below -3 to -14	below 27 to 7	100/0	I = 2.6288 A = -1.2749	I = 2.6424 A = -0.6150 B = 0.0000	I = 2.8281 A = -1.1376	I = 2.4279 A = -0.4367		CAUTION: No holdover time guidelines exist
		75/25	I = 2.5627 A = -1.4921	I = 2.2806 A = -0.5521 B = 0.0000	I = 2.8173 A = -1.2963	I = 3.1111 A = -1.3509		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9438 A = -0.5024	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	107.4	234.9	60.6	106.5	97.0	125.1	65.1	91.3	20.2	130.0
	75/25	57.9	112.2	32.3	53.5	41.2	65.2	27.3	41.0	11.2	82.2
	50/50	18.3	35.5	7.9	16.6	10.6	20.7	7.0	11.1		
-10 / -14 **	100/0	54.7	175.8	60.6	106.5	36.4	107.9	65.7	87.4		
	75/25	33.1	129.9	32.3	53.5	23.6	81.5	16.7	40.4		
-25	100/0	39.1	62.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TABLE 4-10

KILFROST ABC-S

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[2]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.7032 A = -0.7245	I = 2.7666 A = -0.6013 B = -0.2217	I = 2.2743 A = -0.3333	I = 2.5227 A = -0.5326	I = 2.2207 A = -0.4813	
		75/25	I = 2.1889 A = -0.5545	I = 2.5569 A = -0.7273 B = -0.1092	I = 2.1721 A = -0.4710	I = 2.3286 A = -0.5836	I = 2.0484 A = -0.5136	
		50/50	I = 1.6863 A = -0.5068	I = 2.3232 A = -0.8869 B = -0.2936	I = 1.7499 A = -0.5783	I = 1.6395 A = -0.4931		
below -3 to -14	below 27 to 7	100/0	I = 2.4307 A = -1.1131	I = 2.7666 A = -0.6013 B = -0.2217	I = 2.1724 A = -0.5641 or[3] I = 3.0193 A = -1.5395	I = 3.1764 A = -1.5258		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0461 A = -0.9024	I = 2.5569 A = -0.7273 B = -0.1092	I = 2.4843 A = -0.9047 or[3] I = 3.0881 A = -1.6196	I = 3.5272 A = -1.7987		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8469 A = -0.7299	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] Calculate value using both sets of coefficients; take shortest holdover time calculated

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	157.3	305.6	59.0	102.4	80.0	110.0	60.0	85.0	20.8	76.6
	75/25	63.3	105.2	29.1	56.7	44.4	69.6	32.6	47.7	12.2	48.9
	50/50	21.5	34.2	7.6	17.0	12.8	22.2	8.9	12.3		
-10 / -14 **	100/0	44.9	124.6	45.6	79.1	20.2	60.0	11.1	30.0		
	75/25	26.0	59.5	25.6	49.9	19.2	71.1	10.3	33.4		
-25	100/0	21.7	42.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-11

KILFROST ABC-S PLUS

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5882 A = -0.6773	I = 2.7997 A = -0.5886 B = -0.1639	I = 2.1349 A = -0.0810	I = 3.2080 A = -1.0102	I = 2.5437 A = -0.6337	
		75/25	I = 2.4204 A = -0.6975	I = 2.5586 A = -0.5815 B = -0.1638	I = 2.1108 A = -0.2951	I = 2.5019 A = -0.7097	I = 2.4230 A = -0.7288	
		50/50	I = 1.8988 A = -0.5888	I = 2.1742 A = -0.6668 B = 0.0000	I = 2.2203 A = -0.8993	I = 1.7490 A = -0.4516		
below -3 to -14	below 27 to 7	100/0	I = 2.7468 A = -1.4224	I = 2.7997 A = -0.5886 B = -0.1639	I = 2.9992 A = -1.4676	I = 2.3542 A = -0.7931		CAUTION: No holdover time guidelines exist
		75/25	I = 2.3554 A = -1.0359	I = 2.5586 A = -0.5815 B = -0.1638	I = 2.8273 A = -1.3891	I = 2.1553 A = -0.6538		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9370 A = -0.5185	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	130.3	242.3	72.8	124.9	110.8	119.8	62.5	121.0	22.7	126.1
	75/25	85.7	162.3	42.8	72.9	60.5	80.3	32.3	51.4	11.4	82.0
	50/50	30.7	52.7	17.5	32.2	16.5	39.1	13.1	17.6		
-10 / -14 **	100/0	56.6	208.3	60.2	103.2	23.1	94.1	17.6	29.6		
	75/25	42.8	110.6	35.4	60.2	19.1	71.8	17.4	26.7		
-25	100/0	37.5	60.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-12

LYONDELL ARCTIC SHIELD

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4454 A = -0.5452	I = 2.6137 A = -0.5939 B = -0.1143	I = 2.4067 A = -0.5864	I = 2.5402 A = -0.6454	I = 2.3859 A = -0.6640	
		75/25	I = 2.3152 A = -0.5992	I = 2.4438 A = -0.5642 B = -0.1089	I = 2.2230 A = -0.4318	I = 2.4152 A = -0.6779	I = 2.4635 A = -0.7899	
		50/50	I = 1.7122 A = -0.2153	I = 2.1743 A = -0.6196 B = 0.0000	I = 1.8862 A = -0.5423	I = 1.9811 A = -0.6662		
below -3 to -14	below 27 to 7	100/0	I = 2.4503 A = -0.9456	I = 2.6137 A = -0.5939 B = -0.1143	I = 2.8685 A = -1.2952	I = 1.9544 A = -0.4082		CAUTION: No holdover time guidelines exist
		75/25	I = 2.2491 A = -0.7644	I = 2.4438 A = -0.5642 B = -0.1089	I = 2.5673 A = -0.9868	I = 2.0026 A = -0.4621		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8254 A = -0.6370	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	116.0	191.1	50.5	87.1	56.7	99.3	43.4	66.3	13.8	83.5
	75/25	78.8	136.4	37.9	63.6	55.2	83.4	29.3	45.7	9.6	81.5
	50/50	36.5	44.4	20.3	35.9	19.1	32.1	11.2	17.3		
-10 / -14 **	100/0	61.6	146.4	44.2	76.2	26.7	91.9	24.2	31.6		
	75/25	51.9	104.5	33.4	56.0	29.4	75.4	22.7	30.8		
-25	100/0	24.0	43.0	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-13

OCTAGON MAX-FLIGHT

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[3]	Light Freezing Rain[1,5]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5102 A = -0.4343	I = 3.0573 A = -0.7256 B = -0.5146	I = 3.0698 A = -0.9598 B = -0.5585	I = 2.5186 A = -0.6844	I = 2.2790 A = -0.5774	
		75/25	I = 2.4469 A = -0.5051	I = 3.3865 A = -0.9216 B = -0.6492	I = 2.8321 A = -0.6194 B = -0.5809	I = 3.0384 A = -1.0798	I = 1.9460 A = -0.4734	
		50/50	I = 2.2247 A = -0.7089	I = 3.4155 A = -1.1786 B = -0.5058	I = 2.2175 A = -0.6140 B = 0.0000	I = 2.5443 A = -0.9509		
below -3 to -14	below 27 to 7	100/0	I = 2.5385 A = -1.1945	I = 3.0573 A = -0.7256 B = -0.5146	I = 2.8956 or[4] I = 3.0698 A = -1.3456 or[4] A = -0.9598 B = 0.0000 B = -0.5585	I = 2.8529 A = -1.1429		CAUTION: No holdover time guidelines exist
		75/25	I = 2.0440 A = -0.7653	I = 3.3865 A = -0.9216 B = -0.6492	I = 2.5760 A = -1.1285 B = 0.0000	I = 2.6096 A = -1.0396		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8804 A = -0.7843	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^I R^A$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] Regression Equation: $t = 10^I R^A (-T)^B$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[4] Calculate value using both sets of coefficients; take shortest holdover time calculated

[5] Freezing drizzle and light freezing rain values were calculated at 12.7 $g/dm^2/h$ the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 $g/dm^2/h$, values in the holdover time table may differ slightly from those calculated using these coefficients.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	160.9	239.6	48.2	93.8	54.2	135.7	36.5	57.0	15.7	75.1
	75/25	124.1	197.2	44.1	102.6	73.3	132.4	33.8	68.5	11.4	41.2
	50/50	53.6	102.6	26.0	76.4	34.2	61.4	16.4	30.6		
-10 / -14 **	100/0	50.5	151.0	26.5	51.5	24.9	69.3	18.0	38.0		
	75/25	32.3	65.1	20.7	48.2	20.8	61.3	14.3	28.3		
-25	100/0	21.5	44.1	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-14

OCTAGON MAX-FLIGHT 04

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2,3]	Freezing Drizzle[1,4]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.5102 A = -0.4343	I = 3.4634 A = -0.7407 B = -0.7275	I = 2.0949 A = -0.0224	I = 2.4117 A = -0.4124	I = 2.6420 A = -0.6956	
		75/25	I = 2.4469 A = -0.5051	I = 3.2319 A = -0.7946 B = -0.4320	I = 2.1376 A = -0.0817	I = 2.4010 A = -0.4561	I = 2.6645 A = -0.7412	
		50/50	I = 2.2247 A = -0.7089	I = 3.4155 A = -1.1786 B = -0.5058	I = 2.3099 A = -0.6733	I = 2.1734 A = -0.5565		
below -3 to -14	below 27 to 7	100/0	I = 2.5385 A = -1.1945	I = 3.4634 A = -0.7407 B = -0.7275	I = 2.8956 A = -1.3456	I = 2.8529 A = -1.1429	CAUTION: No holdover time guidelines exist	
		75/25	I = 2.0440 A = -0.7653	I = 3.2319 A = -0.7946 B = -0.4320	I = 2.5760 A = -1.1285	I = 2.6096 A = -1.0396		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8804 A = -0.7843	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^I R^A$, where R = rate ($g/dm^2/h$)

[2] Regression Equation: $t = 10^I R^A (2\text{-}T)^B$, where R = rate ($g/dm^2/h$) and T = temperature (in °C)

[3] The upper value in "below -3 to-14", 75/25, snow is 82.6 minutes. This is rounded to 80 minutes in the HOT table, but protocol dictates it should be rounded to 85 minutes.

[4] Freezing drizzle and light freezing rain values were calculated at 12.7 $g/dm^2/h$ the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 $g/dm^2/h$, values in the holdover time table may differ slightly from those calculated using these coefficients.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	160.9	239.6	83.1	163.8	117.5	120.0	68.4	89.6	21.8	143.2
	75/25	124.1	197.2	65.9	136.6	111.3	120.4	58.0	78.2	18.8	140.1
	50/50	53.6	102.6	26.0	76.4	36.3	69.1	24.9	35.8		
-10 / -14 **	100/0	50.5	151.0	35.6	70.3	24.9	90.2	18.0	38.0		
	75/25	32.3	65.1	39.9	82.6	20.8	61.3	14.3	28.3		
-25	100/0	21.5	44.1	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TC HOT Guidelines Regression Information — Winter 2009-2010

TABLE 4-15

OCTAGON MAXFLO

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow or Snow Grains[2]	Freezing Drizzle[1,3]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4846 A = -0.4922	I = 3.0846 A = -0.8545 B = -0.3781	I = 2.4245 A = -0.4699	I = 2.8724 A = -0.9952	I = 2.6663 A = -0.8382	
		75/25	I = 2.2072 A = -0.3970	I = 2.8627 A = -0.9548 B = -0.2641	I = 2.2235 A = -0.5883	I = 2.5582 A = -0.9296	I = 2.4413 A = -0.8179	
		50/50	I = 1.7958 A = -0.7062	I = 2.3140 A = -0.8662 B = -0.3908	I = 1.8698 A = -0.7747	I = 1.8497 A = -0.7307		
below -3 to -14	below 27 to 7	100/0	I = 2.3907 A = -0.7901	I = 3.0846 A = -0.8545 B = -0.3781	I = 2.8619 A = -1.2156	I = 2.4742 A = -0.7046		CAUTION: No holdover time guidelines exist
		75/25	I = 2.1868 A = -0.8254	I = 2.8627 A = -0.9548 B = -0.2641	I = 2.5001 A = -0.8903	I = 2.5267 A = -0.9331		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.9902 A = -0.7098	I = 2.2336 A = -0.7565 B = 0.0000				

[1] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2\text{-}T)^{B}$, where R = rate (g/dm^2/h) and T = temperature (in °C)

[3] Freezing drizzle and light freezing rain values were calculated at 12.7 g/dm^2/h the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 g/dm^2/h, values in the holdover time table may differ slightly from those calculated using these coefficients.

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm^2/h)		Snow (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Freezing Rain (g/dm^2/h)		Cold-Soaked Wing (g/dm^2/h)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	138.2	217.0	42.2	92.4	79.6	124.8	30.3	58.1	12.4	120.3
	75/25	85.1	122.4	22.0	52.9	37.0	64.9	18.1	33.3	8.1	74.1
	50/50	20.1	38.3	6.8	15.0	10.2	21.3	6.7	10.9		
-10 / -14 **	100/0	68.9	142.2	27.2	59.5	32.2	102.9	30.8	48.9		
	75/25	40.7	86.8	16.2	38.9	32.2	75.5	16.7	30.7		
-25	100/0	31.2	59.8	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C

**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C

TABLE 4-16

TYPE IV GENERIC

VERIFICATION TABLE

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog ($g/dm^2/h$)		Snow ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Freezing Rain ($g/dm^2/h$)		Cold-Soaked Wing ($g/dm^2/h$)	
		5	2	25	10	13	5	25	13	75	5
+1 / -3 *	100/0	75.0	152.5	36.2	74.8	38.6	68.9	25.8	39.8	11.2	62.7
	75/25	57.9	105.2	22.0	52.9	34.7	52.1	17.4	28.7	7.1	41.2
	50/50	17.1	34.2	6.8	15.0	10.2	20.4	6.7	10.9		
-10 / -14 *	100/0	19.0	81.3	21.7	40.1	20.2	46.0	11.1	25.8		
	75/25	24.5	51.9	16.2	34.7	14.2	30.6	10.3	18.7		
-25	100/0	17.4	39.4	15.0	30.0						

*Cold-soaked wing calculated at +1°C; all other conditions calculated at -3°C
**Freezing fog and snow calculated at -14°C; freezing drizzle and freezing rain calculated at -10°C