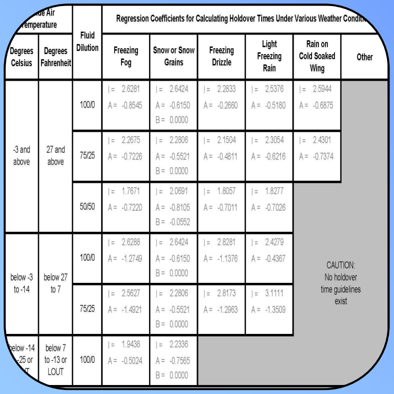
TP 15054E

Regression Coefficients and Equations Used to Develop the Winter 2010-11 Aircraft Ground Deicing Holdover Time Tables



de Air Temperature		Fluid Dilution	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditi					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow or Snow Grains	Freezing Drizzle	Light Freezing Rain	Rain on Cold Soaked Wing	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 -25 or	below 7 to -13 or LOUT	100/0	I = 1.9438 A = -0.5024	I = 2.2336 A = -0.7565 B = 0.0000				

Transport Canada Transports Canada

Canada

Holdover Time (HOT) Regression Information

The information on this page is meant for Holdover Time Determination System (HOTDS) manufacturers only. If you are looking for the Holdover Time (HOT) Guidelines, please **click here** to go back to the previous page.

- Winter 2010-2011 Holdover Time (HOT) Guidelines Regression Information: Original Issue, July 2010

Archive of Obsolete Holdover Time (HOT) Regression Information

Prepared for
Transportation Development Centre

In cooperation with

Civil Aviation
Transport Canada

and

The Federal Aviation Administration
William J. Hughes Technical Center

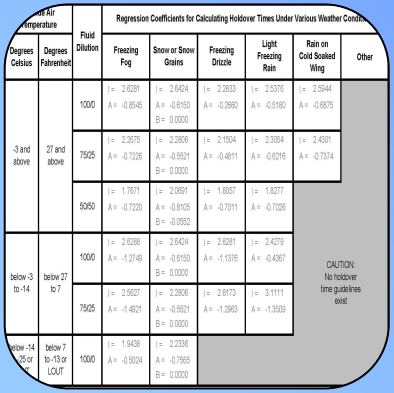
Prepared by:

APS Aviation Inc.

October 2010
Final Version 1.0

TP 15054E

Regression Coefficients and Equations Used to Develop the Winter 2010-11 Aircraft Ground Deicing Holdover Time Tables



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		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		
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Transport Canada Transports Canada

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Holdover Time (HOT) Regression Information

The information on this page is meant for Holdover Time Determination System (HOTDS) manufacturers only. If you are looking for the Holdover Time (HOT) Guidelines, please click here to go back to the previous page.

- Winter 2010-2011 Holdover Time (HOT) Guidelines Regression Information: Original Issue, July 2010

Archive of Obsolete Holdover Time (HOT) Regression Information

by

Stephanie Bendickson

Prepared by:

APS Aviation Inc.

October 2010
Final Version 1.0

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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September 13, 2018

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Date

Reviewed by:

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September 13, 2018

John D’Avirro
Director, Aviation Services

Date

Approved by: **

John Detombe
Chief Engineer
ADGA Group Consultants Inc.

Date

Un sommaire français se trouve avant la table des matières.

*This report was first provided to Transport Canada as Final Draft 1.0 in October 2010.
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***Final Draft 1.0 of this report was signed and provided to Transport Canada in October 2010. A Transport Canada technical and editorial review was subsequently completed and the report was finalized in September 2018; John Detombe was not available to participate in the final review or to sign the current version of the report.*

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 develop holdover time data for all newly-qualified de/anti-icing fluids; and update and maintain the website for the holdover time guidelines;
- To evaluate weather data from previous winters that can have an impact on the format of the holdover time guidelines;
- To develop Type I holdover times for composite surfaces; and evaluate first-step rule for use with composite surfaces;
- To conduct general and exploratory de/anti-icing research;
- To conduct endurance time tests simulating vertical stabilizer anti-icing;
- To conduct endurance time tests in simulated snow pellet conditions;
- To conduct endurance time tests with a snowmaker in an attempt to refine the current test protocol;
- To conduct endurance time tests in heavy snow conditions;
- To support FAA and TC in development of an advisory circular for the implementation of a HOTDS system;
- To evaluate the use of sensors in determining active frost conditions
- To initiate research for development of ice detection capabilities for departing aircraft at the runway threshold;
- To evaluate frost holdover times for use during cold soak wing frost conditions;
- To update the regression coefficient report with the newly-qualified de/anti-icing fluids;
- To conduct endurance time tests on surfaces treated with ice phobic products;
- To evaluate holdover times for anti-icing in a hangar;
- To conduct research at the NRC wind tunnel to further develop and expand ice pellet allowance times; and
- To conduct various aerodynamic research activities at the NRC wind tunnel.

The research activities of the program conducted on behalf of Transport Canada during the winter of 2009-10 are documented in eight reports. The titles of the reports are as follows:

- TP 15050E Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2009-10 Winter;
- TP 15051E Winter Weather Impact on Holdover Time Table Format (1995-2010);
- TP 15052E Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces;

- TP 15053E Aircraft Ground Icing General Research Activities During the 2009-10 Winter;
- TP 15054E Regression Coefficients and Equations Used to Develop the Winter 2010-11 Aircraft Ground Deicing Holdover Time Tables;
- TP 15055E Emerging De/Anti-Icing Technology: Evaluation of Ice Phobic Products for Potential Use in Aircraft Operations;
- TP 15056E Holdover Times Related to Aircraft Hangar Operations; and
- TP 15057E Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics, Winter 2009-10.

In addition, the following interim report is being prepared:

- *Wind Tunnel Research to Support the Development of Ice Pellet Allowance Time Tables.*

This report, TP 15054E, has the following objective:

- To document the regression information required for the winter 2010-11 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 2009-10.

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 Center, 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, Michael Chaput, John D'Avirro, Peter Dawson, Jesse Dybka, Benjamin Guthrie, Michael Hawdur, Eric Perocchio, Michelle Pineau, Marco Ruggi, David Smith, James Smyth, Robert ter Beek, Joey Tiano, David Youssef and Victoria Zoitakis.

Special thanks are extended to Howard Posluns, Angelo Boccanfuso, Yagusha Bodnar, 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.

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Antoine Lacroix for Howard Posluns

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. Since the winter of 2009-10, this information has been published in two documents:

- an online document published on the Transport Canada Holdover Time (HOT) Guidelines website (http://www.tc.gc.ca/eng/civilaviation/standards/commerce-holdovertime-menu-1877.htm), which provides users with the regression information for the current winter's HOT Guidelines in a timely manner in a user friendly format; and
- this TP report, which documents the source of the regression information and how it was obtained.

For the 2010-11 HOT guidelines, regression data was generated for the generic Type I HOT table, eight Type II fluid-specific tables, one Type III fluid-specific table, and sixteen Type IV fluid-specific tables. In addition, regression data was required for Clariant Safewing MP II 1951 and the grandfathered fluid data set in support of the generic Type II HOT Table. The data was predominantly obtained from holdover time testing conducted over the winters of 1996-97 to 2009-10. 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 2009-10.

It is recommended both regression information publications be updated in one year to reflect any changes made to the holdover time guidelines for the winter of 2011-12.

17. Key Words
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

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Antoine Lacroix pour
Howard Posluns

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). 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

Transports Canada doit publier les équations de régression et les coefficients connexes utilisés pour l'élaboration de lignes directrices sur les durées d'efficacité. Depuis l'hiver 2009-2010, cette information a été publiée dans deux documents :

- Un document en ligne publié sur le site Web de Transports Canada sur les lignes directrices des durées d'efficacité : (http://www.tc.gc.ca/fra/aviationcivile/normes/commerce-delaisdefficacite-menu-1877.htm), qui donne aux utilisateurs l'information de régression pour les lignes directrices sur les durées d'efficacité pour l'hiver en cour, en temps opportun et dans un format convivial; et
- Le présent rapport TP, qui documente les sources de l'information de régression et la façon de l'obtenir.

Pour les lignes directrices sur les durées d'efficacité de 2010-2011, 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 seize 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 ont été principalement obtenues à partir d'essais sur les durées d'efficacité tenus au cours des hivers de 1996-1997 à 2009-2010. Plusieurs des données avaient été documentées dans un rapport précédent de Transports Canada et puisées dans 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 2009-2010.

Il est recommandé que les deux publications de régression soient actualisées dans un an pour refléter tout changement apporté aux lignes directrices sur les durées d'efficacité pour l'hiver 2011-2012.

17. Mots clés
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

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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 (HOT) guidelines.

In order for HOTDS to be used by Canadian operators, Transport Canada must make the regression information underlying the HOT Guidelines available to users. Transport Canada publishes two documents on HOT regression information annually:

- an online document, which provides users with the regression information for the current winter's HOT Guidelines in a timely manner in a user-friendly format; and
- this TP report, which documents the sources of the regression information and how it was obtained.

For the 2010-11 HOT Guidelines, regression data was required for the generic Type I HOT table, eight Type II fluid-specific tables, one Type III fluid-specific table, and sixteen Type IV fluid-specific tables. In addition, regression data was required for Clariant Safewing MP II 1951 and the grandfathered fluid data set in support of the generic Type II HOT Table.

The data was predominantly obtained from holdover time testing conducted over the winters of 1996-97 to 2009-10. 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 2009-10, including data for one newly certified fluid, Cryotech Polar Guard (Type IV), one currently qualified fluid, Clariant Safewing MP II Flight (Type II), and data for Type I fluids tested on composite surfaces.

The 2010-11 regression information was published online on the Transport Canada HOT Guidelines website on July 28, 2010 (available here: http://www.tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm). It can be used by HOTDS to calculate holdover times during the winter of 2010-11.

It is recommended that both regression publications – the online document and this report – be updated in one year to reflect any changes made to the HOT Guidelines for the winter of 2011-12.

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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 exploitants canadiens puissent utiliser les HOTDS, Transports Canada doit mettre à la disposition des utilisateurs l'information de régression sous-jacente aux lignes directrices sur les durées d'efficacité. Transports Canada publie annuellement deux documents d'information de régression sur les durées d'efficacité:

- Un document en ligne, qui fournit aux utilisateurs l'information sur la régression, applicable aux lignes directrices de l'hiver en cours sur les durées d'efficacité, en temps opportun et dans un format convivial; et
- Le présent rapport TP, qui documente les sources de l'information de régression et la façon de l'obtenir.

Pour les lignes directrices de 2010-2011 sur les durées d'efficacité, des données de régression étaient requises pour les tableaux de durées d'efficacité des liquides génériques de type I, celles de huit tableaux de liquides spécifiques de type II, pour un tableau spécifique à un liquide de type III et pour seize 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 ont été principalement obtenues d'essais sur les durées d'efficacité tenus au cours des hivers 1996-1997 à 2009-2010. 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 un liquide nouvellement certifié : Cryotech Polar Guard (type IV), un liquide actuellement qualifié, Clariant Safewing MP II Flight (type II), ainsi que les données applicables aux liquides de type I mis à l'essai sur des surfaces composites.

L'information de régression de 2010-2011 a été publiée en ligne sur le site Web de Transports Canada sur les lignes directrices sur les durées d'efficacité le 28 juillet 2010 (disponibles à l'adresse: http://www.tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm).

L’information peut servir aux HOTDS pour le calcul des durées d’efficacité pour l’hiver 2010-2011.

Il est recommandé que les deux publications sur la régression – le document en ligne et le présent rapport – soient actualisées dans un an, afin de refléter tout changement apporté aux lignes directrices sur les durées d’efficacité pour l’hiver 2011-2012.

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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
SAE	SAE International
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 (HOT) Guidelines provide pilots with tables of the protection times provided by de/anti-icing fluids in winter conditions. The values in the HOT 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 HOT 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 HOT Guidelines. These times can be relayed directly to the cockpit. There are several advantages to be gained by using HOTDS in place of HOT tables:

1. **Extended Holdover Times:** Whereas HOT 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 HOT 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 HOT 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 HOT 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. It is expected the same approach will be used for other companies in future.

1.2.2 Publication of Regression Equations and Related Coefficients

The regression equations and coefficients used to calculate the values in the HOT 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 Transport Canada 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 HOT Guidelines.

Following the publication of TP 14873E (1), Transport Canada determined that two regression documents needed to be published annually. Two publications are necessary as users require slightly different information than regulators, and they require this information in a timely manner. The information must be updated annually because the HOT Guidelines are updated annually and changes made to the HOT Guidelines must be reflected in the published regression information. The two documents are summarized below and in Table 1.1.

1. The first document is for HOTDS manufacturers. It provides manufacturers with the current winter's regression information and guidance for its application and use in a user-friendly format. It is published on the Transport Canada HOT Guidelines website, which allows the information to become available in a timely manner, typically in the summer preceding the winter operating season. The document is entitled "*Transport Canada Holdover Time (HOT) Guidelines Regression Information [current winter]*".
2. The second document is a reference document for regulators. Its purpose is to document the sources of the regression information provided in the online document. It is published as a Transport Canada report with a TP number and

may take several years to be published and be made publicly available. The document is entitled "*Regression Coefficients and Equations Used to Develop the Winter [current winter] Aircraft Ground Deicing Holdover Time Tables*". It is not expected users will refer to this document unless they want a better understanding of how HOT table values are derived (something that does not need to be understood to use the regression information with HOTDS).

Table 1.1: Transport Canada Regression Information Publications

	Document 1 (Online Publication)	**Document 2 (TP Report)**
Publication Name	Transport Canada Holdover Time (HOT) Guidelines Regression Information [Current Winter]	Regression Coefficients and Equations Used to Develop the [Current Winter] Aircraft Ground Deicing Holdover Time Tables
Publication Type	Online publication	Transport Canada TP report
Publication Location	Holdover Time Guidelines website (http://www.tc.gc.ca/civilaviation/commerce/holdovertime/menu.htm)	Available from Transport Canada
Purpose	To provide regression information and guidance on its use to HOTDS manufacturers in a timely manner in a user-friendly document	To document the source of the regression information provided in the online publication
Contents	• Regression equations and coefficients required for the current winter's HOT guidelines • Guidance for application and use of regression information, including procedures for calculating generic holdover times	• Methodology to derive holdover times using regression analysis • Methodology used to determine HOT table values (fluid-specific and generic) • History of regression information collection • Source locations for current winter's regression information • Regression information required for the current winter's HOT guidelines (incorporated by including the online publication as an appendix to the report)

1.2.3 History of Regression Information Publications

The history of regression publications is provided in Table 1.2. Following the publication of the initial document for the winter of 2008-09, the two document system was introduced for the winter of 2009-10 and has been followed since that time. It should be noted that each year when new regression documents are created, previous publications become obsolete.

The documents that will be published for the winter of 2010-11 are shown on the last row of the table. These documents are currently the only valid regression publications.

Table 1.2: History of Regression Publications

Winter	Document 1 (Online Publication)	Document 2 (TP Report)
2008-09	No online publication	**Title:** Regression Coefficients and Equations Used to Develop the Winter 2008-09 Aircraft Ground Deicing Holdover Time Tables **TP #:** TP 14873E **Publication Status:** Not yet published by Transport Canada **Validity:** Obsolete
2009-10	**Title:** Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-2010 **Publication Status:** Published online in January 2010 **Validity:** Obsolete	**Title:** Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables **TP #:** TP 14937E **Publication Status:** Not yet published by Transport Canada **Validity:** Obsolete
2010-11	**Title:** Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2010-2011 **Publication Status:** Published online in July 2010 **Validity:** Current	**Title:** Regression Coefficients and Equations Used to Develop the Winter 2010-11 Aircraft Ground Deicing Holdover Time Tables **Publication Status:** Not yet published by Transport Canada **TP #:** TP 15054E **Validity:** Current

1.3 Objectives

The primary objective of this report is to document how and from where the regression information for the 2010-11 winter aircraft ground deicing holdover time tables was obtained. The report also has several secondary objectives:

- Documenting the methodology for deriving holdover times using regression analysis;
- Documenting the methodology used to determine HOT table values (fluid-specific and generic); and
- Providing a history of regression information collection.

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 derive holdover times using regression analysis;
- Section 3 details the methodologies used to derive fluid-specific and generic HOT table values;
- Section 4 presents the data collected for Winter 2010-11 and a short history of data collected in previous winters;
- Section 5 describes the Winter 2010-11 regression information;
- Section 6 presents conclusions derived from the work; and
- Section 7 lists recommendations for future work.

1.5 Note on Frost and Ice Pellets

The HOT Guidelines currently do not provide fluid-specific holdover times in frost conditions; generic holdover times that are not derived from regression analysis are provided for each of the four fluid types in a separate frost HOT table.

The HOT 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 used in the determination of frost holdover times or ice pellet allowance times, regression information is not included for frost, ice pellets or ice pellet mixed conditions in the published regression information.

1.6 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 HOT 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 HOT tables. These differences are detailed in Subsections 3.3 and 3.4. 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.

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2. METHODOLOGY FOR DERIVING HOLDOVER TIMES USING REGRESSION ANALYSIS

The methodology used to derive holdover times using regression analysis is presented in this section. This information is included to provide a better understanding of how holdover time values are derived.

There are two steps to deriving holdover times using regression analysis. The first step is to conduct endurance time testing to enable the collection of an appropriate data set. The second step is to analyse the data set using regression analysis.

2.1 Step 1: Endurance Time Testing

The first step in deriving holdover times using regression analysis is the collection of an appropriate endurance time data set. Endurance time tests 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.

Procedures for conducting endurance time tests have been refined over a number of years, culminating in the current standard approach which has been followed since the 1990s. 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.

There are some differences in the way endurance time tests are carried out in freezing precipitation and in snow, largely due to the difference in control of test variables in natural and simulated conditions.

2.1.1 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 related HOT 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.

The low and high precipitation rates are dependent on the precipitation type. The precipitation rate limits for freezing precipitation are as follows[1]:

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[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 and Endurance Time Testing Program for the 2002-03 Winter* (5).

- 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.

2.1.2 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. An attempt is made to capture data in all snowfall intensities encompassed in the HOT Guidelines.

Three snowfall intensity categories are provided in the Type I and Type III HOT tables. The precipitation rate limits used for the Type I/Type III snowfall intensity categories are[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.

One snowfall intensity category is provided in the Type II and Type IV HOT tables. The precipitation rate limits used for the Type II/Type IV snowfall intensity category are[2]:

- Snow: 10 and 25 g/dm^2/h.

2.2 Step 2: Regression Analysis

Once a complete data set has been collected for a fluid, the data set is subjected to regression analysis. This analysis provides the “raw” holdover time values for the fluid.

Due to the differences in the way data is collected in snow and in freezing precipitation, the protocol for conducting regression analysis differs slightly for freezing precipitation and snow. The freezing precipitation protocol is described in Subsection 2.2.1; the snow protocol is described in Subsection 2.2.2.

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[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.

2.2.1 Freezing Precipitation

The following steps are used to calculate freezing precipitation holdover times using regression analysis:

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)
    - 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 2.1.1) using the resulting regression equation; and

3. Steps 1 and 2 provide "raw" holdover times. Depending on how the times will be used, they may be subject to rounding. For example, Type II/IV raw values are subject to rounding when they are used to develop the Type II and Type IV fluid-specific HOT tables.

2.2.2 Snow

The following steps are used to calculate snow holdover times using regression analysis:

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)
    - 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; and

3. Steps 1 and 2 provide “raw” holdover times. Depending on how the times will be used, they may be subject to rounding. For example, Type II/IV raw values are subject to rounding when they are used to develop the Type II and Type IV fluid-specific HOT tables.

3. METHODOLOGIES FOR DETERMINING HOLDOVER TIME TABLE VALUES

The methodologies for determining fluid-specific and generic HOT table values are presented in this section. This information is included to provide a better understanding of how the HOT tables are built. It is also included as the methodologies determine which regression information is required to be published for each fluid type and if it needs to be updated or changed on an annual basis.

3.1 Methodology for Determining Fluid-Specific HOT Table Values

Fluid-specific holdover times are calculated for most fluids submitted for holdover time testing. They are used to develop the Type II and Type IV fluid-specific HOT tables (which in turn are used to develop the generic Type II and Type IV HOT tables) and to ensure new Type III fluids meet the minimum holdover times set in the generic Type III HOT table.

Fluid-specific holdover times are derived directly from regression analysis as described in the methodology detailed in Section 2.

In the case of Type II and Type IV fluids, the regression-generated “raw” holdover times described in Section 2 are subject to rounding to produce the values in the Type II and Type IV fluid-specific tables. The Type II/IV rounding protocol is as follows:

1. Raw values are rounded to the nearest whole “5” digit. For example, 55.1 to 57.4 minutes is rounded down to 55 minutes and 57.5 to 59.9 minutes is rounded up to 60 minutes;
2. 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;
3. Snow, freezing drizzle, freezing rain, and rain on cold-soaked wing values are capped at 2 hours; and
4. Freezing fog values are capped at 4 hours.

It should also be noted that 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.

3.2 Methodology for Determining Type II/IV Generic HOT Table Values

The Type II and Type IV generic HOT table values represent the most conservative (shortest) holdover times of all available Type II / Type IV fluids. The purpose of these tables is to provide operators with the minimum amount of holdover time that may be available in a given weather condition when the operator does not know which fluid is being used. Since there is no one fluid that underperforms all other fluids in all weather conditions, an analysis is necessary to develop a table that provides the shortest holdover times of all the relevant fluids in each weather condition represented in the tables.

The list of fluids provided in the Transport Canada HOT Guidelines is used to determine which fluids are included in the Type II and Type IV generic analyses. Table 5-2 in the HOT Guidelines provides the list of Type II fluids; Table 5-4 provides the list of qualified Type IV fluids. These lists are updated on an annual basis as new fluids are added and old fluids are removed. (Refer to note on qualified fluids in Subsection 3.2.1.)

It should be noted that SAE International (SAE) standards stipulate that all fluids that qualify as Type IV fluids also automatically qualify as Type II fluids. Therefore, the Type IV fluids from Table 5-4 of the HOT Guidelines are also included in the Type II generic analysis.

3.2.1 Note on Qualified Fluids

When the qualification of a Type II or Type IV fluid expires and is not renewed, the fluid remains on the Transport Canada list of fluids for four years. If the fluid has a fluid-specific HOT table, it remains in the guidelines for four years.

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).

As the protocol for conducting the Type II and Type IV generic analyses requires all fluids on the list of fluids be included in the analyses, the data for these fluids also remains in the generic analyses during the four years.

The result of this protocol is that all fluids included in the HOT Guidelines and in the generic analysis may not actually be currently qualified fluids. As the regression information is provided in support of the HOT Guidelines, it too must include information for all fluids that appear in the HOT 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 Aerospace Recommended Practice (ARP) 5718, Section 5.12.3 (2). The protocol stipulates fluids be removed from the HOT Guidelines four years after fluid qualification has expired.

3.3 Evolution of Type I Generic HOT Table Values

Unlike the Type II/IV generic HOT table values, there is no specific protocol in place for determining Type I generic HOT table values. Also unlike the Type II/IV values, the Type I generic values are relatively static and do not change as new Type I fluids are added and removed from the list of qualified fluids.

The reason for the static nature of the Type I generic table is that a significant body of research and testing has shown that all Type I fluids formulated with glycol perform in a similar manner from an endurance time perspective. New glycol-based fluids are no longer required to undergo endurance time testing.

As a result of extensive research and testing showing that holdover times of Type I fluids are shorter on composite surfaces than on aluminum surfaces, holdover times for Type I fluids on composite surfaces were added to the holdover time guidelines starting in winter 2010-11. The existing Type I holdover times remained in place for aluminum surfaces.

A summary of how the current Type I holdover times were derived and the data sets that were used in their determinations is provided below.

- The **Type I aluminum snow** holdover times are derived from regression analysis of the 2001-02 Type I snow data set. Testing was conducted in the winter of 2001-02 using a new test protocol and a number of representative Type I fluids. The tests are documented in the Transport Canada report, TP 13994E, *Generation of Holdover Times Using the New Type I Fluid Test Protocol* (3).

- The **Type I aluminum freezing precipitation** holdover times are not derived from regression analysis. They were established in the early 1990s and substantiated by testing conducted up to and including the winter of 1995-96. The values in the “below -3 to -6°C” row were added in the winter of 2003-04 following testing with five representative Type I fluids in the winter of 2002-03. A detailed description of the evolution of the Type I aluminum freezing precipitation holdover times is provided in Appendix B of the Transport Canada report TP 15052E, *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces* (4). Tests conducted for the “below -3 to -6°C” row are documented in Subsection 8.4.2 of the Transport Canada report, TP 14144E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2002-03 Winter* (5).

- The **Type I composite snow** holdover times were derived from regression analysis of the Type I composite snow data set, which includes data collected in the winters of 2006-07, 2007-08 and 2009-10. A detailed description of this data and the derivation of the Type I composite snow holdover times from the data is provided in the Transport Canada report, TP 15052E, *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces* (4).

- The **Type I composite freezing precipitation** holdover times were derived from endurance time testing conducted in 2009-10. Although regression analysis formed part of the analysis that determined the holdover time values, the holdover times were not derived directly from the regression analysis. A detailed description of the data set and the methodology used to derive the Type I composite freezing precipitation holdover times is provided in the Transport Canada report, TP 15052E, *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces* (4).

3.3.1 Differences in Transport Canada and FAA Type I HOT Values

It should be noted that the Transport Canada and FAA Type I generic HOT values differ 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.

3.4 Evolution of Type III Generic HOT Table Values

Like the Type I generic HOT table values, there is no specific protocol in place for determining Type III generic HOT table values. Also, like the Type I values, the Type III generic values are static and have not changed 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 Type III fluid on the list of qualified fluids. The following protocol was used to obtain the generic values:

- Endurance time tests were conducted with Clariant Safewing 2031;
- Fluid-specific holdover times were calculated for Clariant Safewing 2031;
- The fluid-specific values were reduced by 10 percent; and
- 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; they thought that by reducing and rounding its test values, they could establish minimum holdover times that any new Type III fluids submitted for testing would meet.

3.4.1 Differences in Transport Canada and FAA Type III HOT Values

It should be noted that the FAA Type III generic HOT 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.

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4. DATA COLLECTION

The regression information underlying the HOT Guidelines was first collected and published in support of the winter 2008-09 HOT Guidelines. Since that time, the regression information has been updated annually to reflect the annual changes made to the HOT Guidelines. This chapter describes the evolution of the regression information (Subsection 4.1) and the regression information collected for the 2010-11 HOT Guidelines (Subsection 4.2).

Subsection 4.1 includes a year-by-year summary of the data collected, added, and removed and any changes made to the way the information is published.

Subsection 4.2 details the data required, collected and removed for the winter 2010-11 publication and includes the source locations of the data contained in the 2010-11 publication.

4.1 Evolution of Regression Information

In the past, the regression information underlying the HOT Guidelines was not published in a format that was appropriate for use with HOTDS. The data was published only as part of the annual report on holdover time testing conducted by APS, and only the regression information for the fluids tested in a given year was published that year. That meant that the regression information was not readily available; multiple publications, some not yet available to the public, had to be consulted to obtain the data. Further complications, such as the testing of some fluids over multiple winters, made it very difficult for HOTDS manufacturers to accurately obtain the correct data.

4.1.1 Initial Data Collection (2008-09 Holdover Time Guidelines)

The first regression information publication was developed over the winters of 2006-07 and 2007-08 in support of the winter 2008-09 HOT Guidelines. As the regression information 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 and the complete contents of the initial database are 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).

4.1.2 Changes Required for 2009-10 Holdover Time Guidelines

The regression information was updated in 2009 to reflect changes made to the HOT Guidelines for use in the winter of 2009-10.

1. Data was collected and added to the regression database for three new fluids that were added to the HOT Guidelines in 2009-10:
    - Aviation Shaanxi Hi-tech Cleanwing II (Type II);
    - ABAX Ecowing AD-49 (Type IV); and
    - Kilfrost ABC-4^{sustain} (Type IV).
2. Data was removed from the regression publication for two fluids which became obsolete and were removed from the HOT Guidelines in 2009-10:
    - Aviation Xi'an Hi-tech KHF-II (Type II); and
    - Kilfrost ABC-II Plus (Type II).

This work is 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* (6).

Work was completed in the Fall of 2009 to develop the first online publication for the regression information. The 2009-10 online document, *Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2009-2010*, was published on the Transport Canada HOT Guidelines website in January 2010.

4.2 Data for the 2010-11 Holdover Time Guidelines

The data required for the 2010-11 HOT Guidelines is detailed in this section. The data is detailed by fluid type: Type I in Subsection 4.2.1, Type II in Subsection 4.2.2, Type III in Subsection 4.2.3 and Type IV in Subsection 4.2.4.

Each subsection includes:

1. Data Required: a description of the data required for the fluid type;
2. Data Source(s): the original source location of the required data;
3. Data Collection: where the data was collected from for the 2010-11 publication; and
4. Data Removal: a description of any data removed from the regression publication for winter 2010-11.

Table 4.1, at the end of this chapter, summarizes the data included in the winter 2010-11 regression publication.

4.2.1 Type I

4.2.1.1 Data Required

Regression information is required for the generic Type I HOT table. As fluid-specific HOT tables are not published for Type I fluids, no additional regression information is required.

4.2.1.2 Data Source(s)

The **Type I aluminum snow** holdover times are derived from regression analysis of the 2001-02 Type I snow data set (see Subsection 3.3). The data set is documented in the Transport Canada report, TP 13994E, *Generation of Holdover Times Using the New Type I Fluid Test Protocol* (3).

The **Type I aluminum freezing precipitation** holdover times are not derived from regression analysis (see Subsection 3.3). The Type I aluminum freezing precipitation coefficients were created in 2008 from the values in the 2008-09 Type I HOT table.

The **Type I composite snow** holdover times are derived from regression analysis of the Type I composite snow data set (which includes data from tests conducted in 2006-07, 2007-08 and 2009-10, see Subsection 3.3). The data set is documented in the Transport Canada report, TP 15052E, *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces* (4).

The **Type I composite freezing precipitation** holdover times are based on data collected in 2009-10 but are not derived directly from regression analysis (see Subsection 3.3). The data is documented in the Transport Canada report, TP 15052E, *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces* (4). However, as the holdover times are not derived directly from regression analysis, TP 15052E (4) does not include regression information. The Type I freezing precipitation coefficients were created in 2010 from the 2010-11 holdover time values. Appendix C provides a summary of the data used and regressions completed to obtain the required information.

4.2.1.3 Data Collection

The Type I aluminum surface regression information was collected previously (see Table 4.1) and therefore was obtained from the previous regression publication, TP 14937E (6).

The Type I composite surface regression information was new this year. The snow regression information was collected from TP 15052E (4) and the freezing precipitation regression information was collected from the data provided in Appendix C.

4.2.1.4 Data Removed

No Type I data was removed from the HOT Guidelines in 2010-11; therefore, no Type I data was removed from the regression publication.

4.2.2 Type II

4.2.2.1 Data Required

Regression information is required for the eight Type II fluid-specific HOT tables in the 2010-11 HOT Guidelines:

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

Regression information is also required for the Type II generic HOT table. As detailed in Subsection 3.2, the generic Type II HOT table values are based on the shortest holdover times of all fluids on the list of Type II fluids and the list of Type IV fluids[4]. The majority of this data is collected for the fluid-specific tables; however, there are two fluids on the list of qualified Type II fluids that do not have fluid-specific tables, and obtaining data for these fluids is somewhat more complicated.

1. **Clariant Safewing MP II 1951:** Due to concerns that arose with the viscosity of this fluid many years ago, regulators decided to discontinue publishing fluid-specific holdover times for the fluid. However, it remained on the list of qualified fluids and was permitted to be used with the Type II generic HOT Guidelines. Over the years, the Clariant Safewing MP II 1951 fluid-specific data has remained in the Type II generic analysis to account for the performance of the fluid.

2. **Kilfrost ABC-3:** When this fluid came to the market in the early 1990s, fluid-specific testing was not completed with Type II fluids and therefore no fluid-specific data exists for it. When the “worst-performing fluid” methodology was adopted for developing the Type II generic table, it was necessary to find a way to incorporate the performance of these early fluids which did not have fluid-specific data in the generic analysis (these fluids were dubbed “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. The 1998-99 data set is now referred to as the grandfathered fluid data set and it must be included in the regression information so long as Kilfrost ABC-3 or any other grandfathered fluid is on the list of qualified fluids.

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[4] See comment on definition and use of the term “qualified fluid” in Subsection 3.2.1.

It should be noted that although the grandfathered fluid data set and Clariant Safewing MP II 1951 regression information is published, it is only for use in the calculation of the generic Type II holdover times and 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.

4.2.2.2 Data Source(s)

The majority of Type II regression information is 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 4.1). This data is available from the reports on holdover time testing published annually.

The grandfathered fluid data set is an exception. The regression coefficients for this data set were created from the 1998-99 Type II generic HOT table values. This was done for the original regression publication in 2008 (see Subsection 4.1.1, item 5).

4.2.2.3 Data Collection

Regression information for all of the Type II fluids was collected previously (see Table 4.1) and therefore was obtained from the previous regression publication, TP 14937E (6).

However, additional testing was conducted with a lower viscosity sample of Clariant Safewing MP II Flight in 2009-10 which resulted in changes being made to the fluid-specific holdover times for the fluid. This resulted in additional regression information having to be collected. This data was collected from the Transport Canada Report TP 15050E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2009-10 Winter* (7), which documents the results of holdover time testing conducted in 2009-10.

4.2.2.4 Data Removed

No Type II fluids were removed from the HOT Guidelines in 2010-11; therefore, no Type II data was removed from the regression publication.

4.2.3 Type III

4.2.3.1 Data Required

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

4.2.3.2 Data Source(s)

Type III fluid-specific regression information is derived from holdover time testing conducted with Clariant Safewing MP III 2031 ECO. The holdover time testing was carried out over several winters (see Table 4.1). The data is available in the reports on holdover time testing published for the years the fluid was tested.

4.2.3.3 Data Collection

The regression information for Clariant Safewing MP III 2031 ECO was collected previously (see Table 4.1) and therefore was obtained from the previous regression publication, TP 14937E (6).

4.2.3.4 Data Removed

No Type III fluids or data were removed from the HOT Guidelines for 2010-11; therefore, no Type III data was removed from the regression publication.

4.2.4 Type IV

4.2.4.1 Data Required

Regression information is required for the sixteen Type IV fluid-specific HOT tables in the 2010-11 HOT Guidelines:

1. ABAX AD-480;
2. ABAX Ecowing AD-49;
3. Clariant Safewing MP IV 2001;

4. Clariant Safewing MP IV 2012 Protect;
5. Clariant Safewing MP IV Launch;
6. Cryotech Polar Guard;
7. Dow Chemical UCAR FlightGuard AD-480;
8. Dow Chemical UCAR AD-49;
9. Dow Chemical UCAR™ ADF/AAF ULTRA+;
10. Dow Chemical UCAR™ Endurance EG106;
11. Kilfrost ABC-4^{sustain};
12. Kilfrost ABC-S;
13. Kilfrost ABC-S Plus;
14. Lyondell ARCTIC Shield;
15. Octagon Max-Flight 04; and
16. Octagon MaxFlo.

Regression information is also required for the Type IV generic HOT table. As detailed in Subsection 3.2, the generic Type IV HOT table values are based on the shortest holdover times of all fluids on the list of Type IV fluids[5]. As all Type IV fluids have fluid-specific HOT tables, and regression information is collected for the fluid-specific tables, no additional regression information is required to calculate the generic Type IV holdover times.

4.2.4.2 Data Source(s)

Type IV fluid-specific regression information is derived from holdover time testing conducted with the associated Type IV fluids. The holdover time testing has been carried out over many years (see Table 4.1). The data is available in the reports on holdover time testing published annually.

4.2.4.3 Data Collection

Regression information for fourteen of the sixteen Type IV fluids was collected previously (see Table 4.1) and was obtained from the previous regression publication, TP 14937E (6). Regression information for the two remaining fluids was collected this year:

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[5] See comment on definition and use of the term "qualified fluid" in Subsection 3.2.1.

1. Regression information for Cryotech Polar Guard, which was newly qualified for 2010-11, was collected from the Transport Canada Report TP 15050E, *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2009-10 Winter* (7), which documents the results of holdover time testing conducted with this fluid; and

2. Regression information for Dow Chemical UCAR AD-49 was taken from previously published regression information. Dow Chemical UCAR AD-49 is identical to ABAX Ecowing AD-49 and therefore the regression information for Dow UCAR AD-49 was used for ABAX Ecowing AD-49.

4.2.4.4 Data Removed

One Type IV fluid, Octagon Max-Flight, was removed from the HOT Guidelines for 2010-11. The regression information for the fluid was correspondingly removed from the regression publication.

4.2.5 Summary

Table 4.1 lists the regression data sets that are required for the 2010-11 HOT Guidelines and their respective sources. The first column specifies the fluid type and 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 was examined to determine which data set is responsible for the fluid-specific values in the associated HOT 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.

4.2.6 Formatting Changes

Two formatting changes were made to the regression information publication for the winter of 2010-11.

1. The snow columns in all HOT tables (Types I/II/II/IV) in the HOT Guidelines were modified to include snow pellets for winter 2010-11. The snow columns in the regression coefficients tables and verification tables (Types I/II/II/IV) were correspondingly modified to include snow pellets.

2. The column titled “freezing rain” in all verification tables (Types I/II/II/IV) was modified to use the correct terminology, “light freezing rain”, which is already in use in the HOT tables and in the regression coefficients tables.

4.2.7 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 HOT table for each fluid. This information was cross-referenced with the values provided in the published generic and fluid-specific HOT tables. The values were the same, ensuring the regression coefficients are correct.

Table 4.1: Regression Data Sets Required for 2010-11

Fluid Type: Data Set Name	Source of Regression Data	Year Added to Regression Publication
Type I: Generic (Aluminum Snow)	HOT Testing: 2001-02	2008-09
Type I: Generic (Composite Snow)	HOT Testing: 2006-07, 2007-08, 2009-10	2010-11
Type I: Generic (Aluminum Freezing Precipitation)	Created from 2008-09 HOT table values	2008-09
Type I: Generic (Composite Freezing Precipitation)	Created from 2010-11 HOT table values	2010-11
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, 2009-10	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

Table 4.1: Regression Data Sets Required for 2010-11 (cont'd)

Fluid Type: Data Set Name	Source of Regression Data	Year Added to Regression Publication
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
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: Cryotech Polar Guard	HOT Testing: 2009-10	2010-11
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 FlightGuard AD-49	HOT Testing: 2008-09 (with identical fluid ABAX AD-49)	2010-11
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 04	HOT Testing: 2000-01	2008-09
Type IV: Octagon MaxFlo	HOT Testing: 2004-05	2008-09

5. REGRESSION INFORMATION PUBLICATION: 2010-11

The regression information underlying the 2010-11 Transport Canada HOT Guidelines is provided on the Transport Canada HOT Guidelines website (www.tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm) in a document entitled, *Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2010-2011*. A copy of this document is included as Appendix B.

The online publication is a 37 page document which includes: a summary of changes page, guidance material, regression coefficients tables and verification tables.

The contents of the document are described in this chapter.

5.1 Summary of Changes

The summary of changes, included at the front of the document, provides a detailed account of the changes that were made to the document contents for 2010-11. This includes the addition/removal/changes to any fluids (presented by fluid type) and a description of any formatting changes.

5.2 Guidance Material

The regression information publication contains guidance for using the information contained in the document. This includes guidance on how to interpret the information in the regression coefficients tables, its applicability, and how to calculate generic holdover times for each fluid type. It also provides a description of the verification tables and their purpose, and describes several limitations of the data (discussed in this document in Subsection 5.5).

5.3 Regression Coefficients Tables

There are 28 regression coefficients tables in the 2010-11 regression information publication. A list of the regression coefficients tables provided in the 2010-11 regression publication is provided in Table 5.1.

Fluids are listed in alphabetical order by fluid type. There is one Type I table, ten Type II tables, one Type III table and sixteen Type IV tables.

Table 5.1: Regression Coefficients Tables for Winter 2010-11

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 • Cryotech Polar Guard • Dow Chemical UCAR ADF/AAF Ultra+ • Dow Chemical UCAR Endurance EG106 • Dow Chemical UCAR FlightGuard AD-480 • Dow Chemical UCAR FlightGuard AD-49 • Kilfrost ABC-4^{sustain} • Kilfrost ABC-S • Kilfrost ABC-S Plus • Lyondell ARCTIC Shield • 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 4.2.2.1.

5.3.1 Table Format and Footnotes

Each regression coefficients table is presented in the format of its corresponding HOT 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 4.2.5). 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 HOT Guidelines.

As per the protocol described in Subsection 3.1, 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+.

5.4 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 5.1.

Verification tables are also provided for the generic Type II and generic Type IV HOT tables. The values in these tables were determined using the methodologies for calculating Type II and Type IV generic holdover times detailed in Subsection 3.2.

Each verification table provides holdover time values for the boundary conditions for each cell in the associated HOT 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.

5.5 Data Limitations

There are several limitations of the regression coefficients and equations data that must be considered by users of the data. These limitations are described in the guidance section of the regression information publication and detailed below.

5.5.1 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.

5.5.2 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.

5.5.3 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 HOT tables (see Subsection 2.1).

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 5.1. 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.

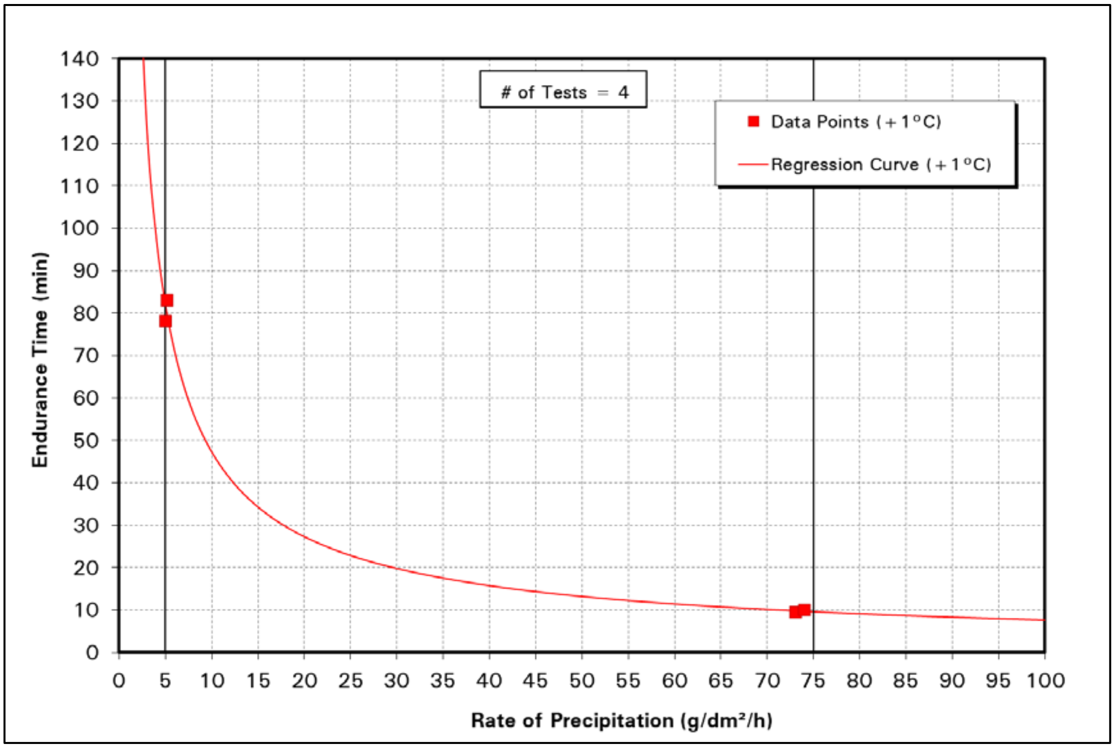

Figure 5.1: Sample Regression Curve – Cold-Soaked Wing

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6. CONCLUSIONS

The regression information required for the 2010-11 HOT Guidelines was published online in July 2010 in the document entitled, *Transport Canada Holdover Time (HOT) Guidelines Regression Information Winter 2010-2011*. The document is available on the Transport Canada HOT Guidelines website, which can be accessed at: www.tc.gc.ca/CivilAviation/commerce/HoldoverTime/menu.htm.

The data required, collected and removed for the 2010-11 online publication is documented in this report. The data was predominantly collected from the 2009-10 regression publication, although additional data was collected from the results of endurance time testing conducted in 2009-10. The data is primarily sourced from the results of holdover time testing conducted from the winters of 1996-97 to 2009-10.

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 2010-11. 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 HOT 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 HOT 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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7. RECOMMENDATIONS

Due to the dynamic nature of the HOT 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. 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.

4. Bendickson, S., Ruggi, M., *Development of Type I Fluid Holdover Times for Use on Aircraft with Composite Surfaces*, APS Aviation Inc., Transportation Development Centre, Montreal, May 2011, TP 15052E, XX (to be published).

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

6. Bendickson, S., *Regression Coefficients and Equations Used to Develop the Winter 2009-10 Aircraft Ground Deicing Holdover Time Tables,* APS Aviation Inc., Transportation Development Centre, Montreal, December 2009, TP 14937E, XX (to be published).

7. Bendickson, S., *Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2009-10 Winter*, APS Aviation Inc., Transportation Development Centre, Montreal, September 2010, TP 15050E, XX (to be published).

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APPENDIX A

TRANSPORTATION DEVELOPMENT CENTRE WORK STATEMENT EXCERPT – AIRCRAFT & ANTI-ICING FLUID WINTER TESTING 2009-10

TRANSPORTATION DEVELOPMENT CENTRE
WORK STATEMENT EXCERPT –
AIRCRAFT & ANTI-ICING FLUID
WINTER TESTING 2009-10

5.7 RESEARCH INFORMATION DISSEMINATION

5.7.3 Update: Regression Coefficients Used to Compute Holdover Times

a) Update regression coefficients tables and verification tables to reflect changes made to the holdover time guidelines for the winter 2010-11 operating season;

b) Prepare online guidance material formatted similarly to the HOT guidelines that contain regression coefficient tables; and

c) Prepare a final report to document the applicable regression coefficients and verification tables required for the winter of 2010-11.

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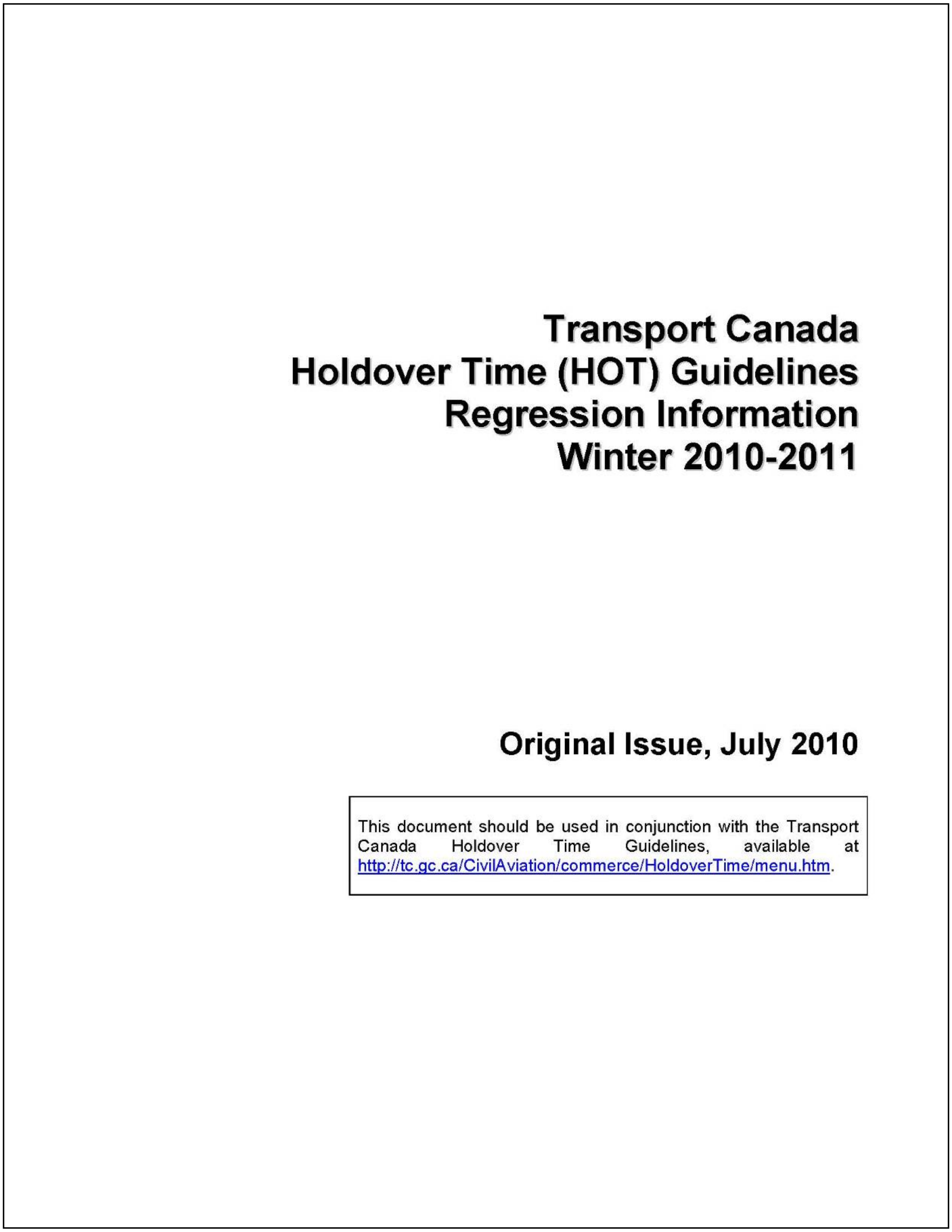
APPENDIX B

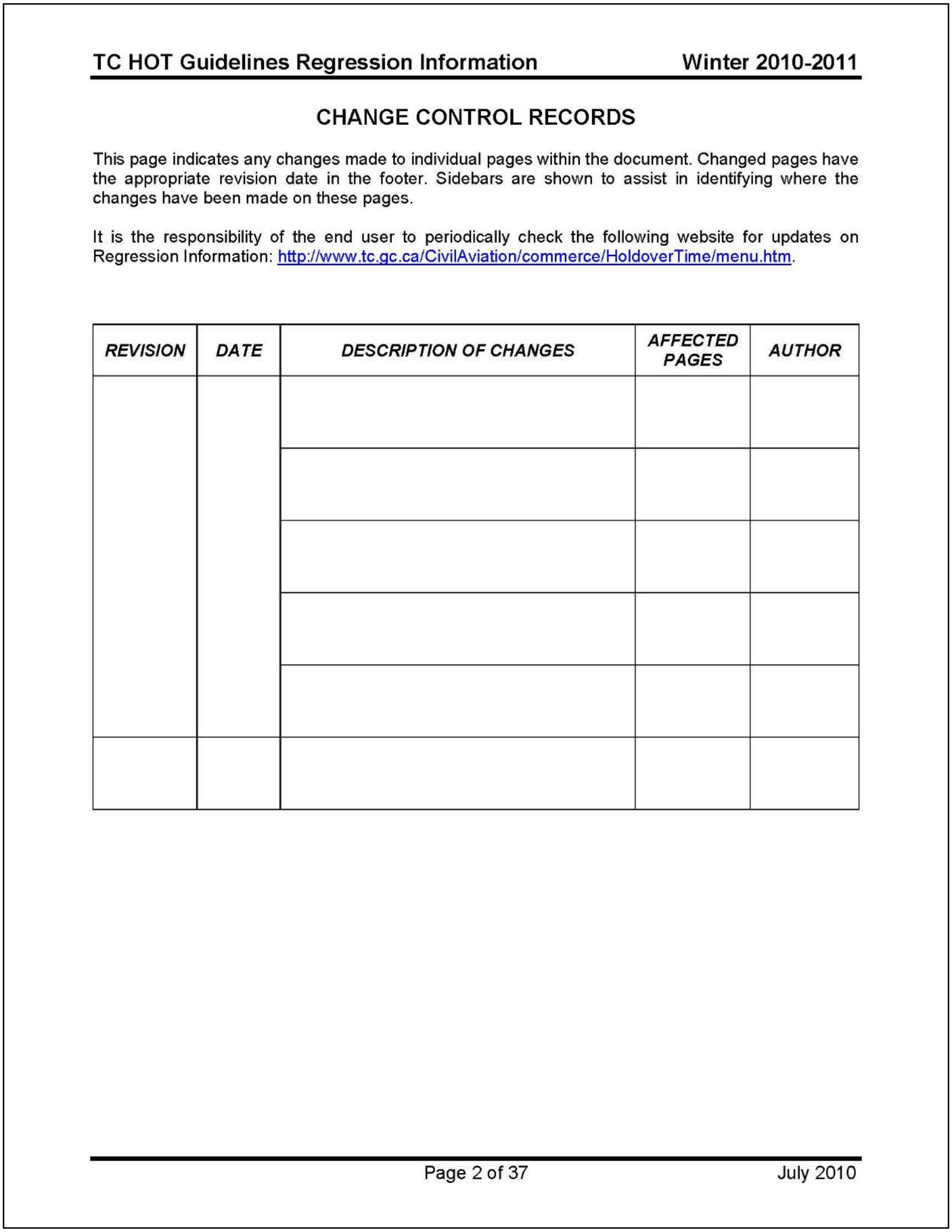
TRANSPORT CANADA
HOLDOVER TIME (HOT) GUIDELINES
REGRESSION INFORMATION
WINTER 2010-11



Transport Canada
Holdover Time (HOT) Guidelines
Regression Information
Winter 2010-2011

Original Issue, July 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.



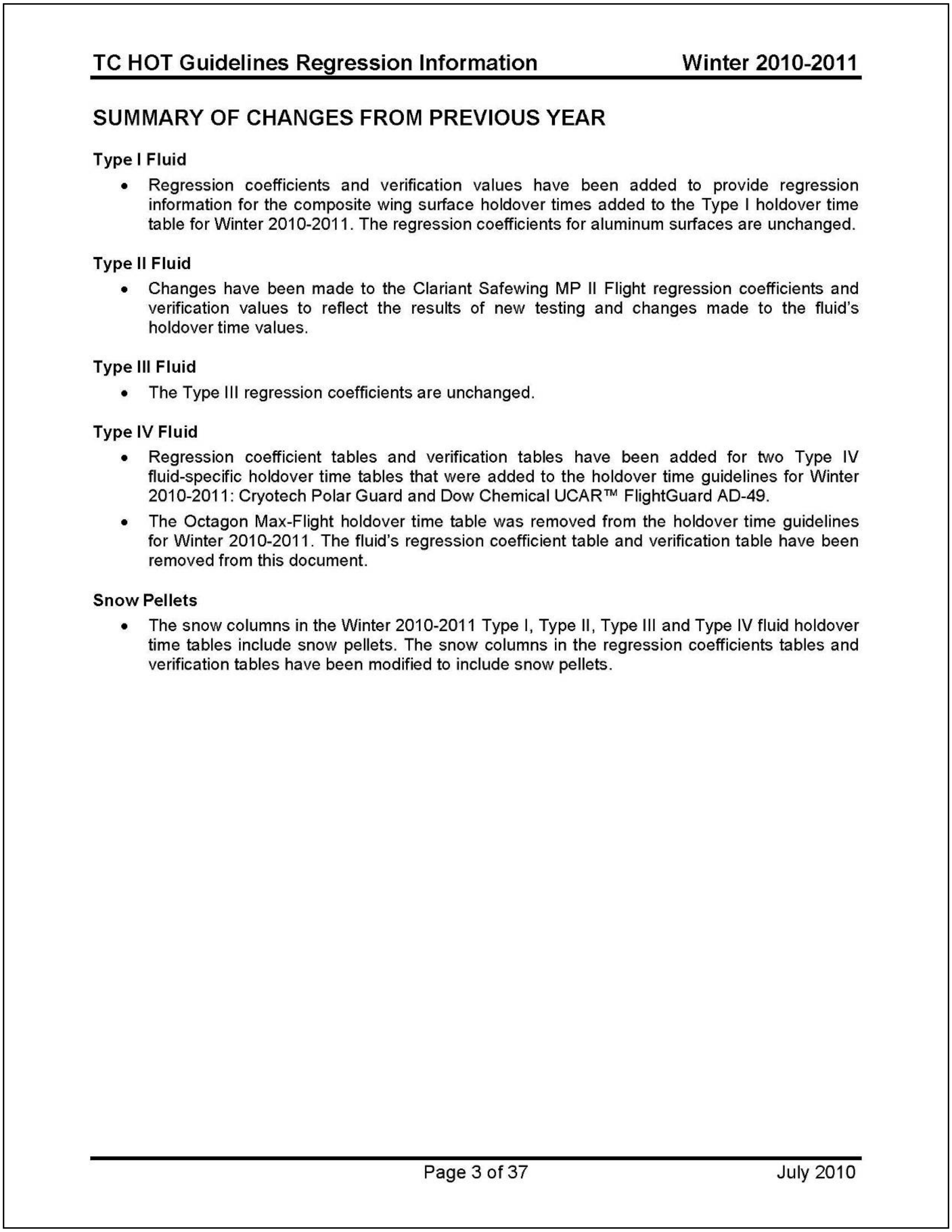
TC HOT Guidelines Regression Information **Winter 2010-2011**

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



SUMMARY OF CHANGES FROM PREVIOUS YEAR

Type I Fluid

- Regression coefficients and verification values have been added to provide regression information for the composite wing surface holdover times added to the Type I holdover time table for Winter 2010-2011. The regression coefficients for aluminum surfaces are unchanged.

Type II Fluid

- Changes have been made to the Clariant Safewing MP II Flight regression coefficients and verification values to reflect the results of new testing and changes made to the fluid's holdover time values.

Type III Fluid

- The Type III regression coefficients are unchanged.

Type IV Fluid

- Regression coefficient tables and verification tables have been added for two Type IV fluid-specific holdover time tables that were added to the holdover time guidelines for Winter 2010-2011: Cryotech Polar Guard and Dow Chemical UCAR™ FlightGuard AD-49.
- The Octagon Max-Flight holdover time table was removed from the holdover time guidelines for Winter 2010-2011. The fluid's regression coefficient table and verification table have been removed from this document.

Snow Pellets

- The snow columns in the Winter 2010-2011 Type I, Type II, Type III and Type IV fluid holdover time tables include snow pellets. The snow columns in the regression coefficients tables and verification tables have been modified to include snow pellets.

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 15054E, *Regression Coefficients and Equations Used to Develop the Winter 2010-11 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.

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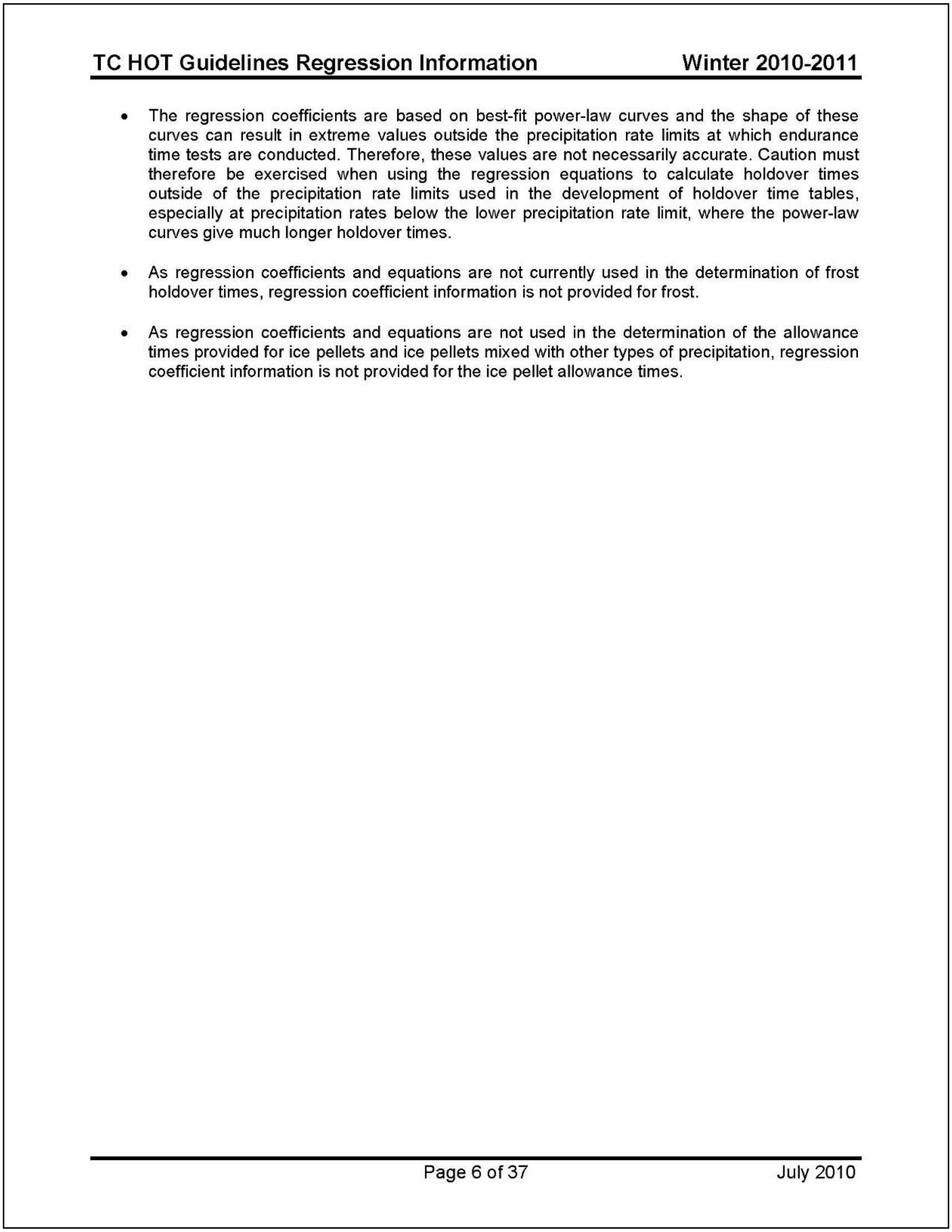
[1] The issue of temperatures above 0°C will be addressed in future releases of the associated exemption document.

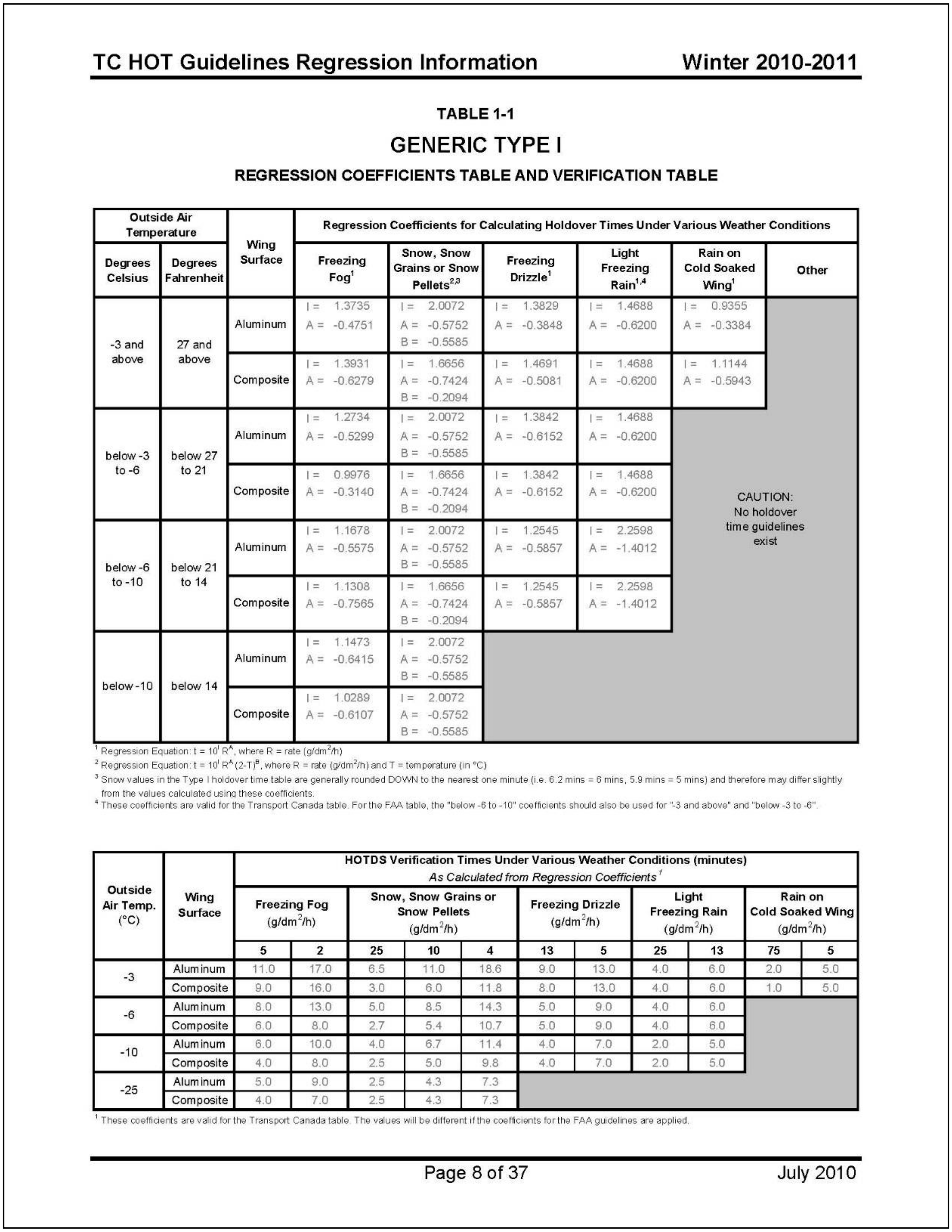


- The regression coefficients are based on best-fit power-law curves and the shape of these curves can result in extreme values outside the precipitation rate limits at which endurance time tests are conducted. Therefore, these values are not necessarily accurate. Caution must therefore be exercised 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 2010-2011

TABLE 1-1

GENERIC TYPE I

REGRESSION COEFFICIENTS TABLE AND VERIFICATION TABLE

Outside Air Temperature		Wing Surface	Regression Coefficients for Calculating Holdover Times Under Various Weather Conditions					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog[1]	Snow, Snow Grains or Snow Pellets[2,3]	Freezing Drizzle[1]	Light Freezing Rain[1,4]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	Aluminum	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	
		Composite	I = 1.3931 A = -0.6279	I = 1.6656 A = -0.7424 B = -0.2094	I = 1.4691 A = -0.5081	I = 1.4688 A = -0.6200	I = 1.1144 A = -0.5943	
below -3 to -6	below 27 to 21	Aluminum	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		
		Composite	I = 0.9976 A = -0.3140	I = 1.6656 A = -0.7424 B = -0.2094	I = 1.3842 A = -0.6152	I = 1.4688 A = -0.6200	CAUTION: No holdover time guidelines exist	
below -6 to -10	below 21 to 14	Aluminum	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		
		Composite	I = 1.1308 A = -0.7565	I = 1.6656 A = -0.7424 B = -0.2094	I = 1.2545 A = -0.5857	I = 2.2598 A = -1.4012		
below -10	below 14	Aluminum	I = 1.1473 A = -0.6415	I = 2.0072 A = -0.5752 B = -0.5585				
		Composite	I = 1.0289 A = -0.6107	I = 2.0072 A = -0.5752 B = -0.5585				

[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/h) and T = temperature (in °C)

[3] Snow values in the Type I holdover time table are generally 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)	Wing Surface	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*[1]										
		Freezing Fog (g/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)			Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/h)	
		5	2	25	10	4	13	5	25	13	75	5
-3	Aluminum	11.0	17.0	6.5	11.0	18.6	9.0	13.0	4.0	6.0	2.0	5.0
	Composite	9.0	16.0	3.0	6.0	11.8	8.0	13.0	4.0	6.0	1.0	5.0
-6	Aluminum	8.0	13.0	5.0	8.5	14.3	5.0	9.0	4.0	6.0		
	Composite	6.0	8.0	2.7	5.4	10.7	5.0	9.0	4.0	6.0		
-10	Aluminum	6.0	10.0	4.0	6.7	11.4	4.0	7.0	2.0	5.0		
	Composite	4.0	8.0	2.5	5.0	9.8	4.0	7.0	2.0	5.0		
-25	Aluminum	5.0	9.0	2.5	4.3	7.3						
	Composite	4.0	7.0	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.

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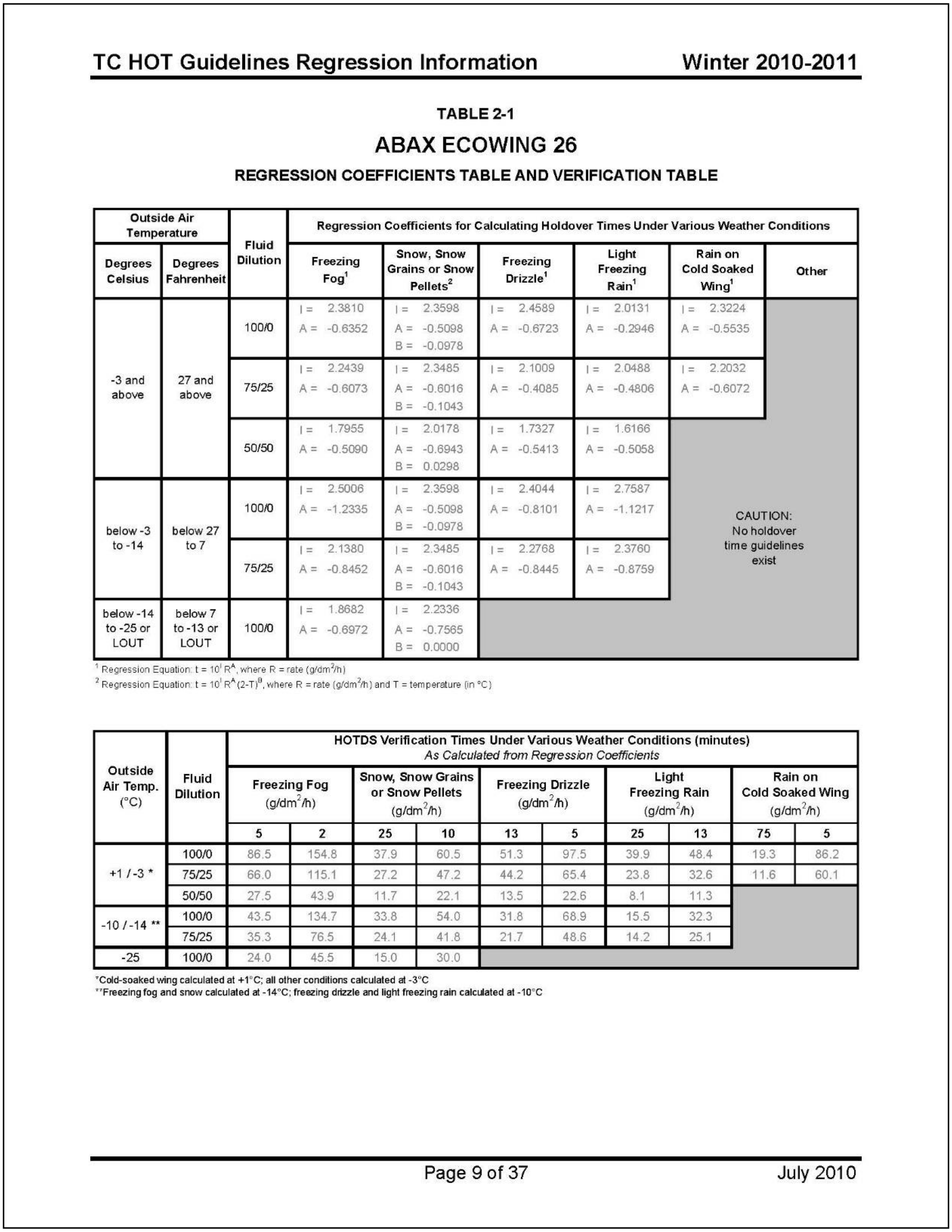

TC HOT Guidelines Regression Information **Winter 2010-2011**

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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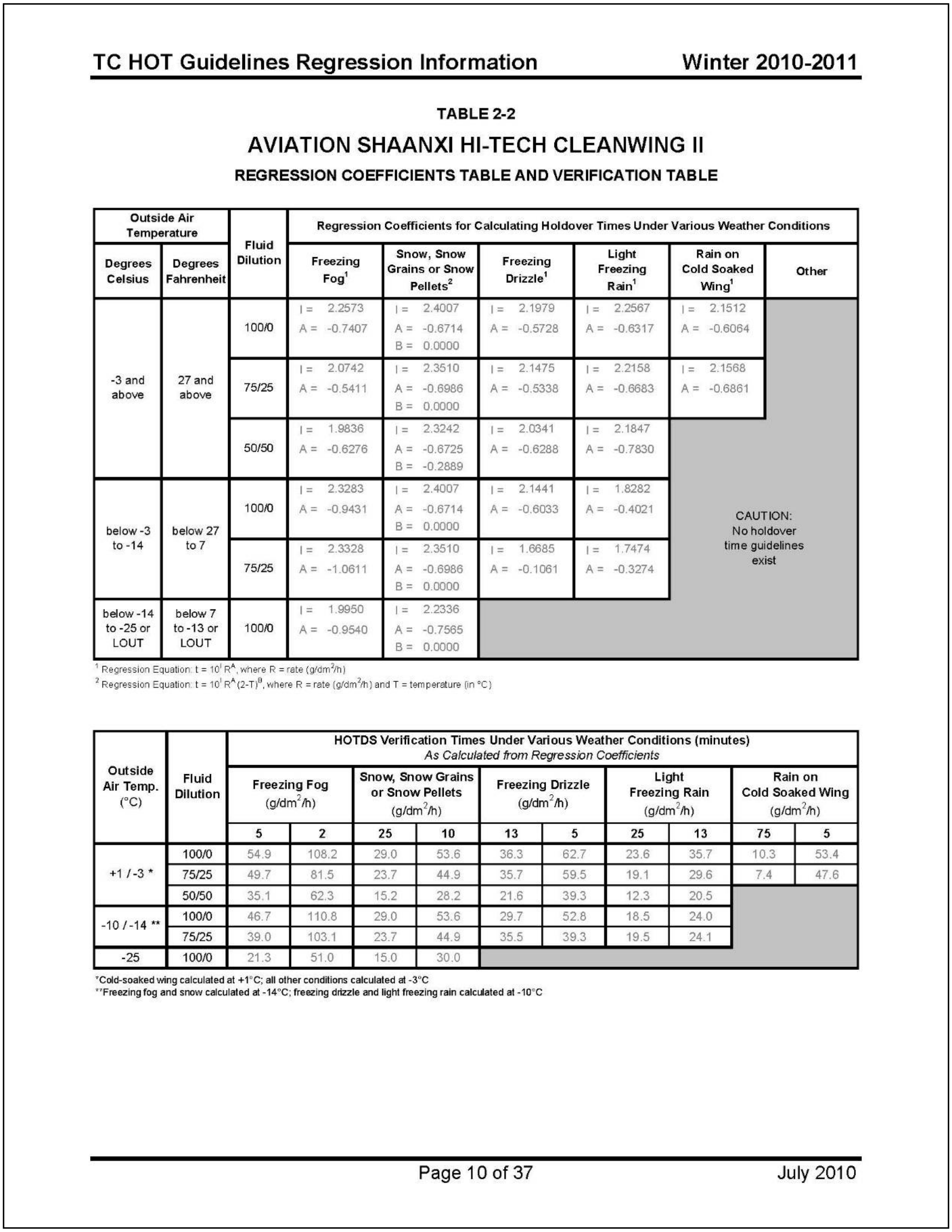

TC HOT Guidelines Regression Information **Winter 2010-2011**

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, Snow Grains or Snow Pellets[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: $t = 10^I R^A (2-T)^B$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C

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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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist
		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		
		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.

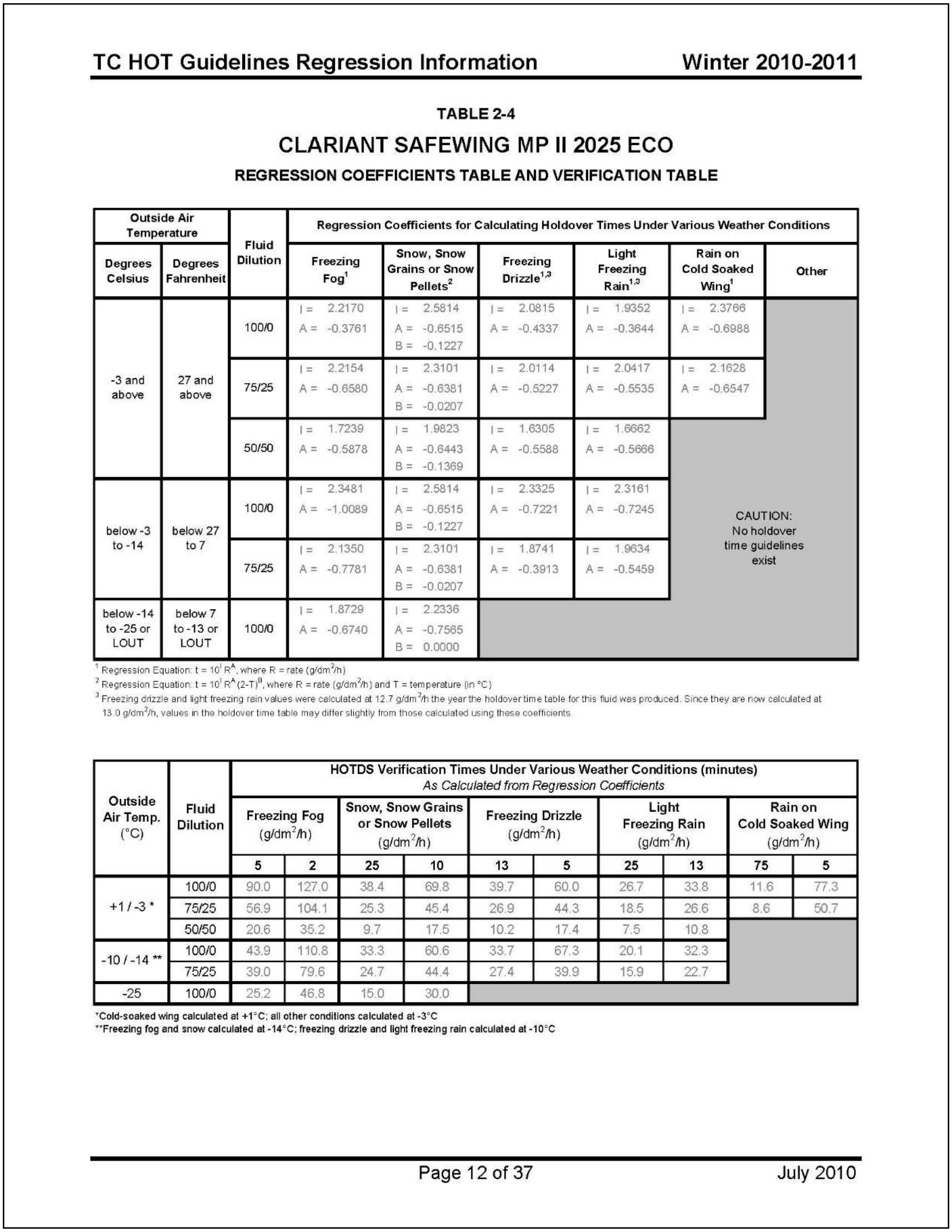
[2] Regression Equation: $t = 10^{I} R^{A}$, where R = rate (g/dm^2/h)

[3] Regression Equation: $t = 10^{I} R^{A} (2-T)^{B}$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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: $t = 10^I R^A (2-T)^B$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C

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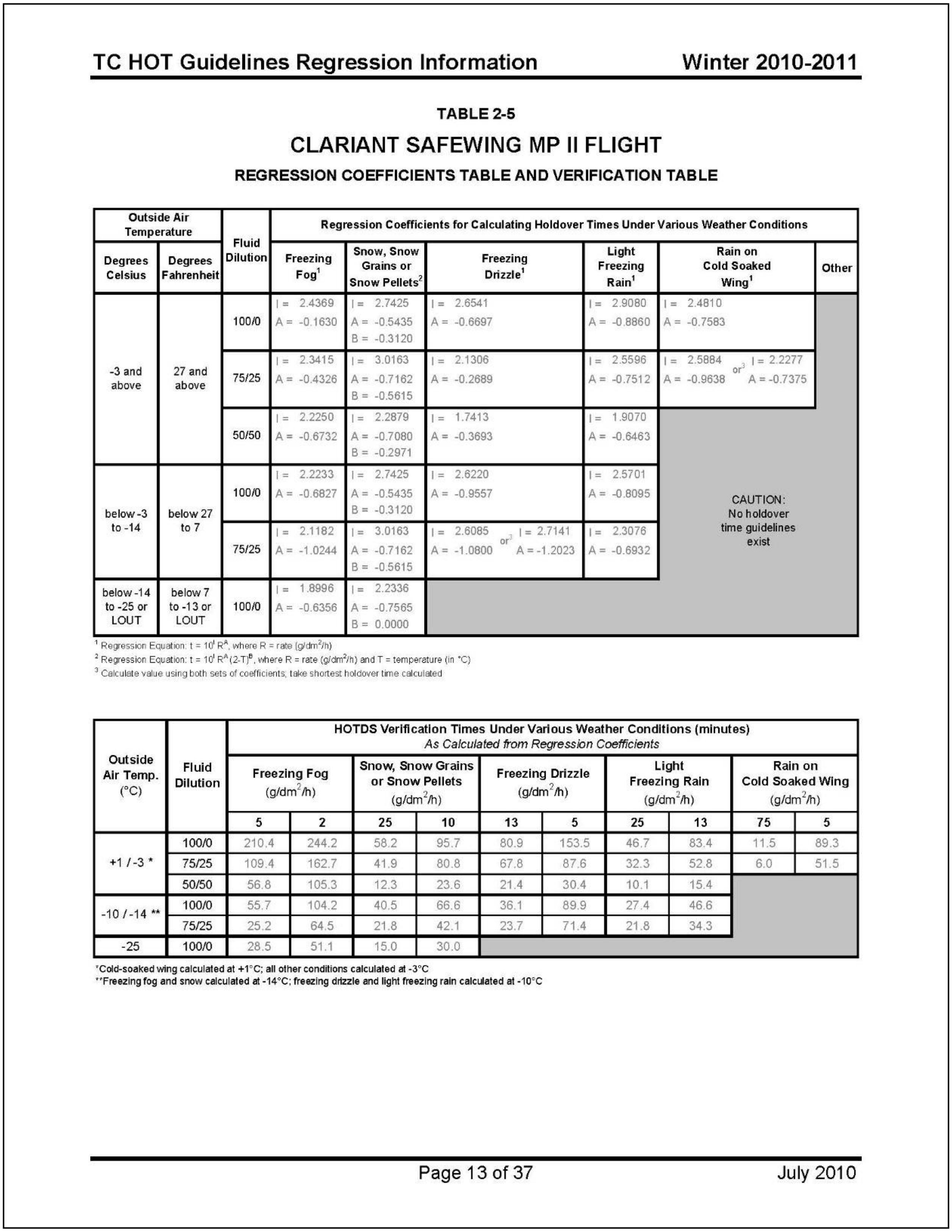

TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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 = 2.3415 A = -0.4326	I = 3.0163 A = -0.7162 B = -0.5615	I = 2.1306 A = -0.2689	I = 2.5596 A = -0.7512	I = 2.5884 A = -0.9638 or[3] I = 2.2277 A = -0.7375	
		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	CAUTION: No holdover time guidelines exist	
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		
		75/25	I = 2.1182 A = -1.0244	I = 3.0163 A = -0.7162 B = -0.5615	I = 2.6085 A = -1.0800 or[3] I = 2.7141 A = -1.2023	I = 2.3076 A = -0.6932		
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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		**Snow, Snow Grains or Snow Pellets (g/dm²/h)**		**Freezing Drizzle (g/dm²/h)**		**Light Freezing Rain (g/dm²/h)**		**Rain on Cold Soaked Wing (g/dm²/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	109.4	162.7	41.9	80.8	67.8	87.6	32.3	52.8	6.0	51.5
	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	25.2	64.5	21.8	42.1	23.7	71.4	21.8	34.3		
-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 light freezing rain calculated at -10°C

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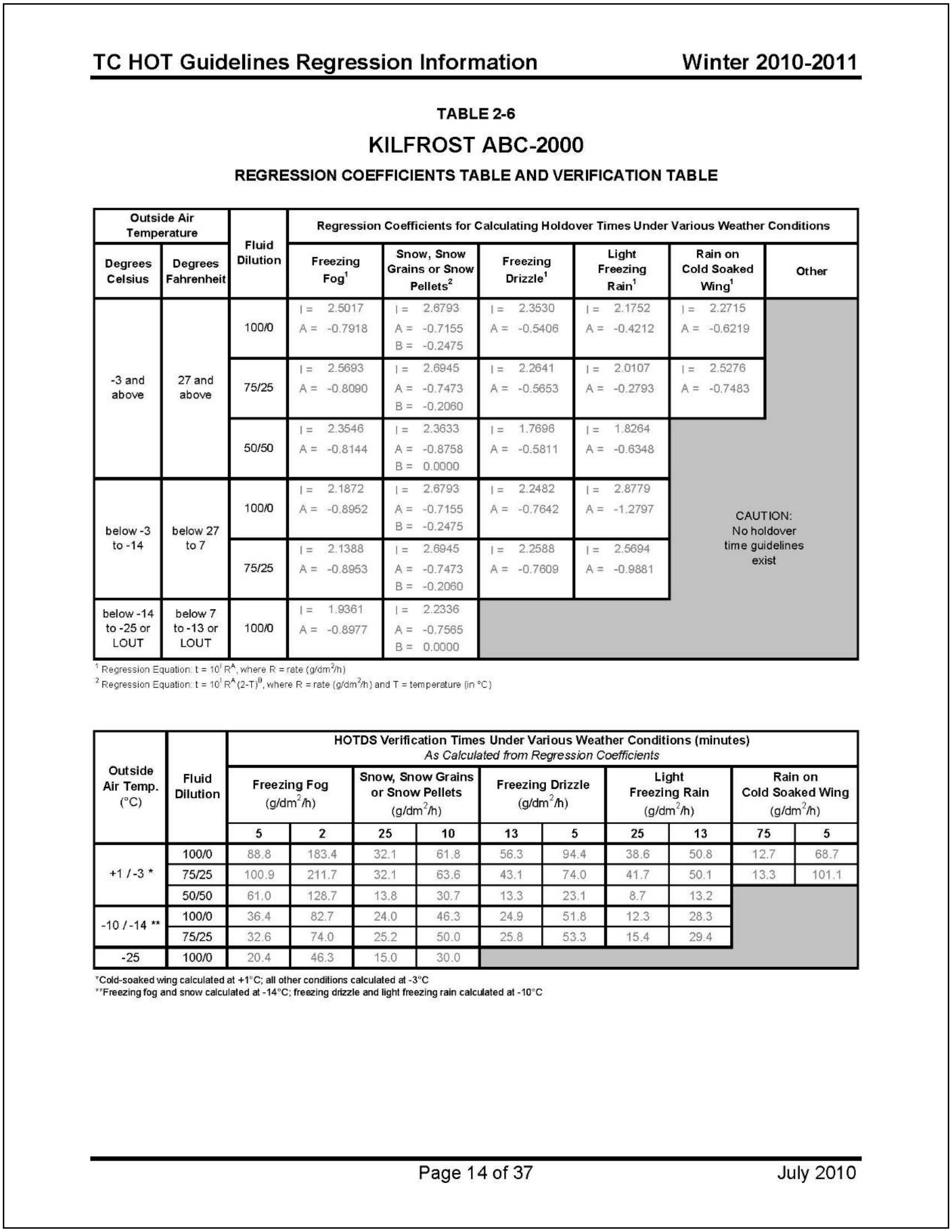

TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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: $t = 10^I R^A (2-T)^B$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C

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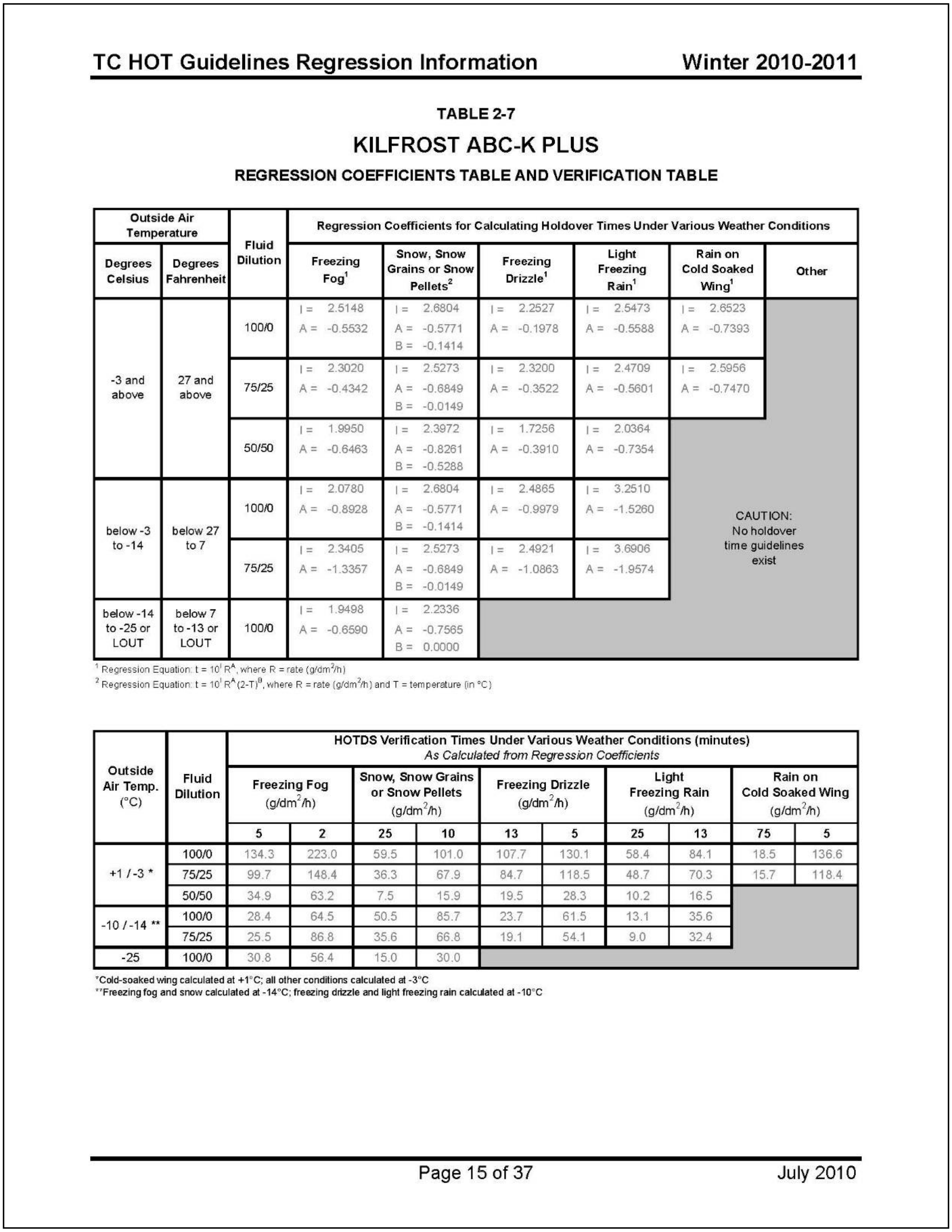


TABLE 2-7

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, Snow Grains or Snow Pellets[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				

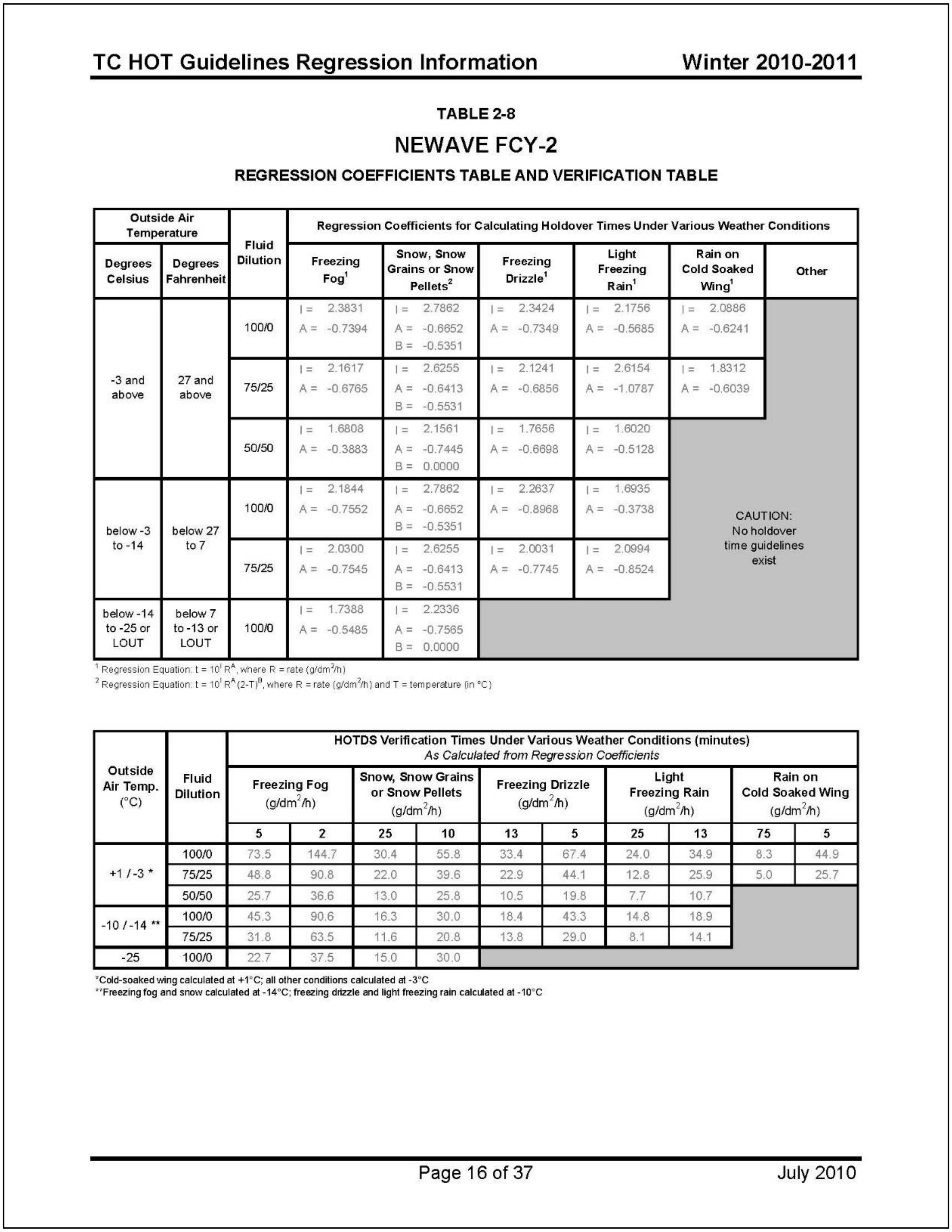
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^{I} R^{A}(2-T)^{B}$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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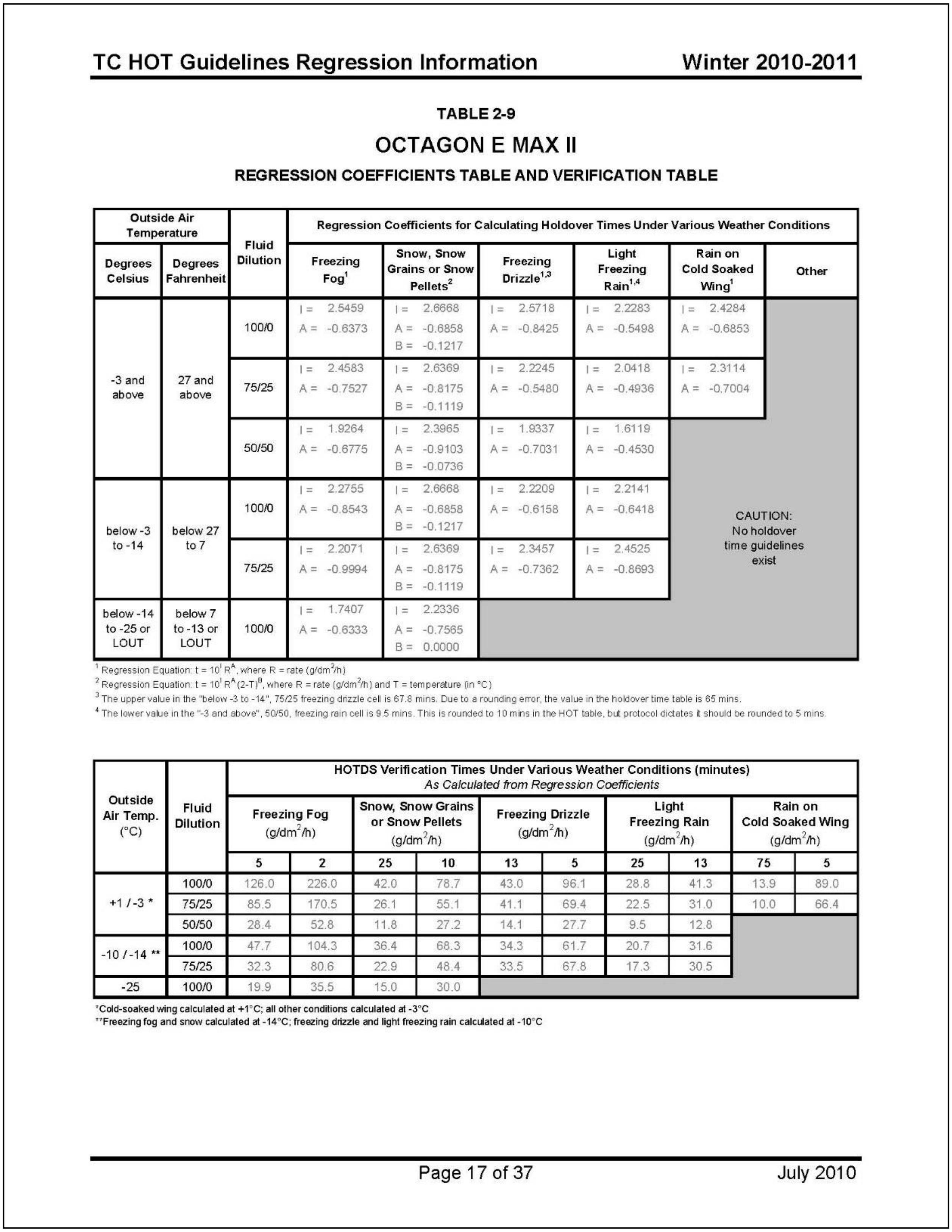


TABLE 2-9

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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist
		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		
		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: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm^2/h) and T = temperature (in °C)

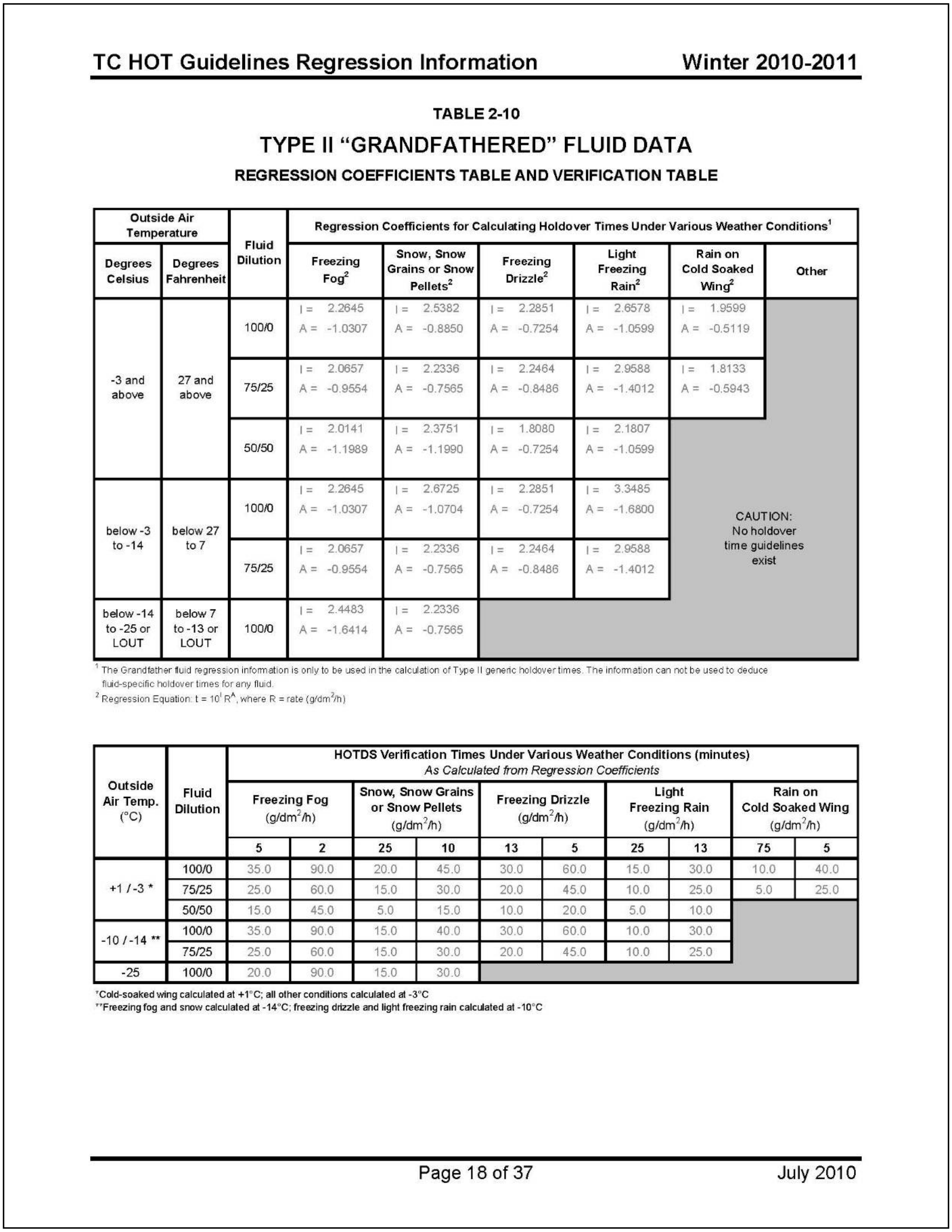
[3] The upper value in the "below -3 to -14", 75/25 freezing drizzle cell is 67.8 mins. Due to a rounding error, the value in the holdover time table is 65 mins.

[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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information **Winter 2010-2011**

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, Snow Grains or Snow Pellets[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	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, Snow Grains or Snow Pellets ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Light Freezing Rain ($g/dm^2/h$)		Rain on 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 light freezing rain calculated at -10°C

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TABLE 2-11

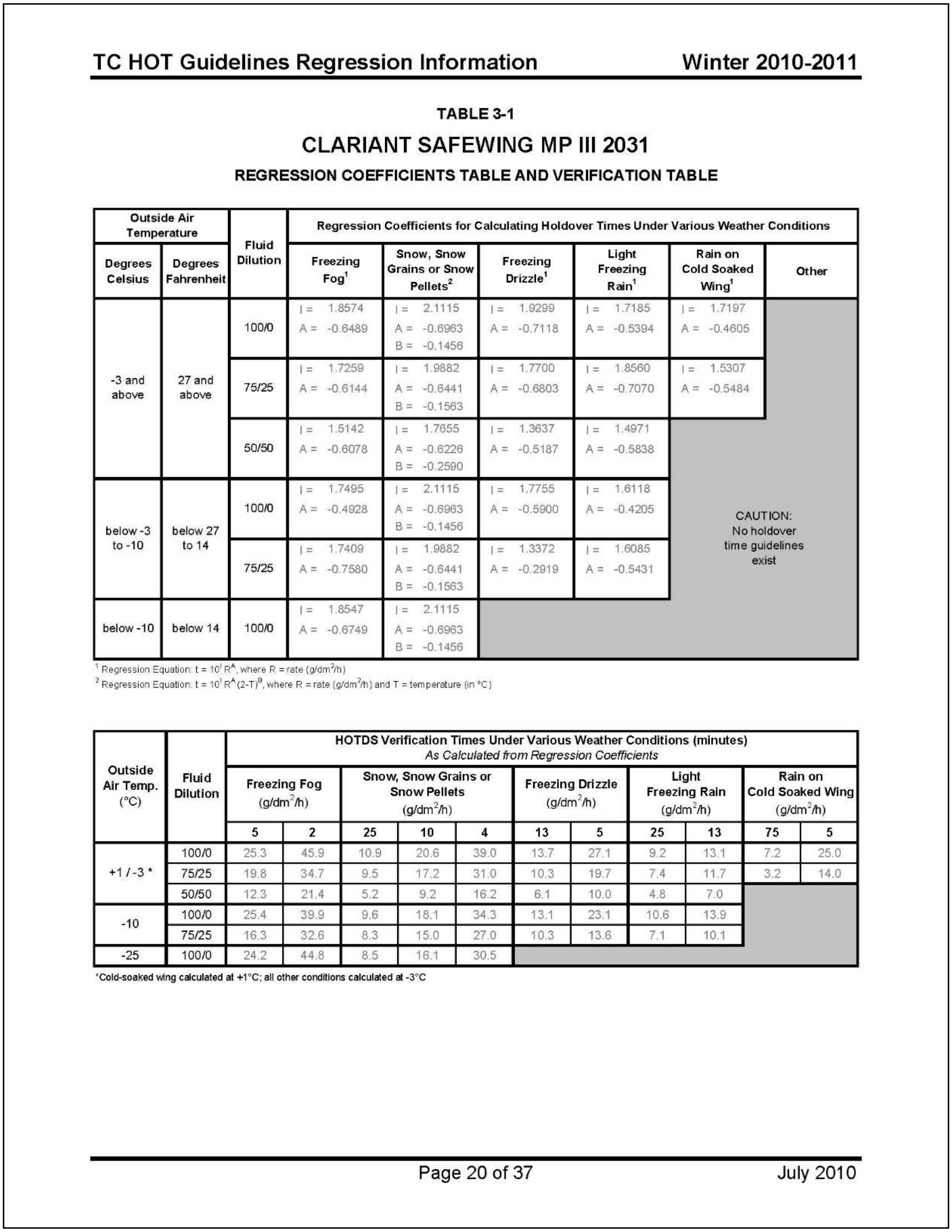
TYPE II GENERIC

VERIFICATION TABLE

Outside Air Temp. (°C)	Fluid Dilution	HOTDS Verification Times Under Various Weather Conditions (minutes) *As Calculated from Regression Coefficients*									
		Freezing Fog (g/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Cold-Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist
		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		
		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/dm²/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2-T)^{B}$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)			Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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

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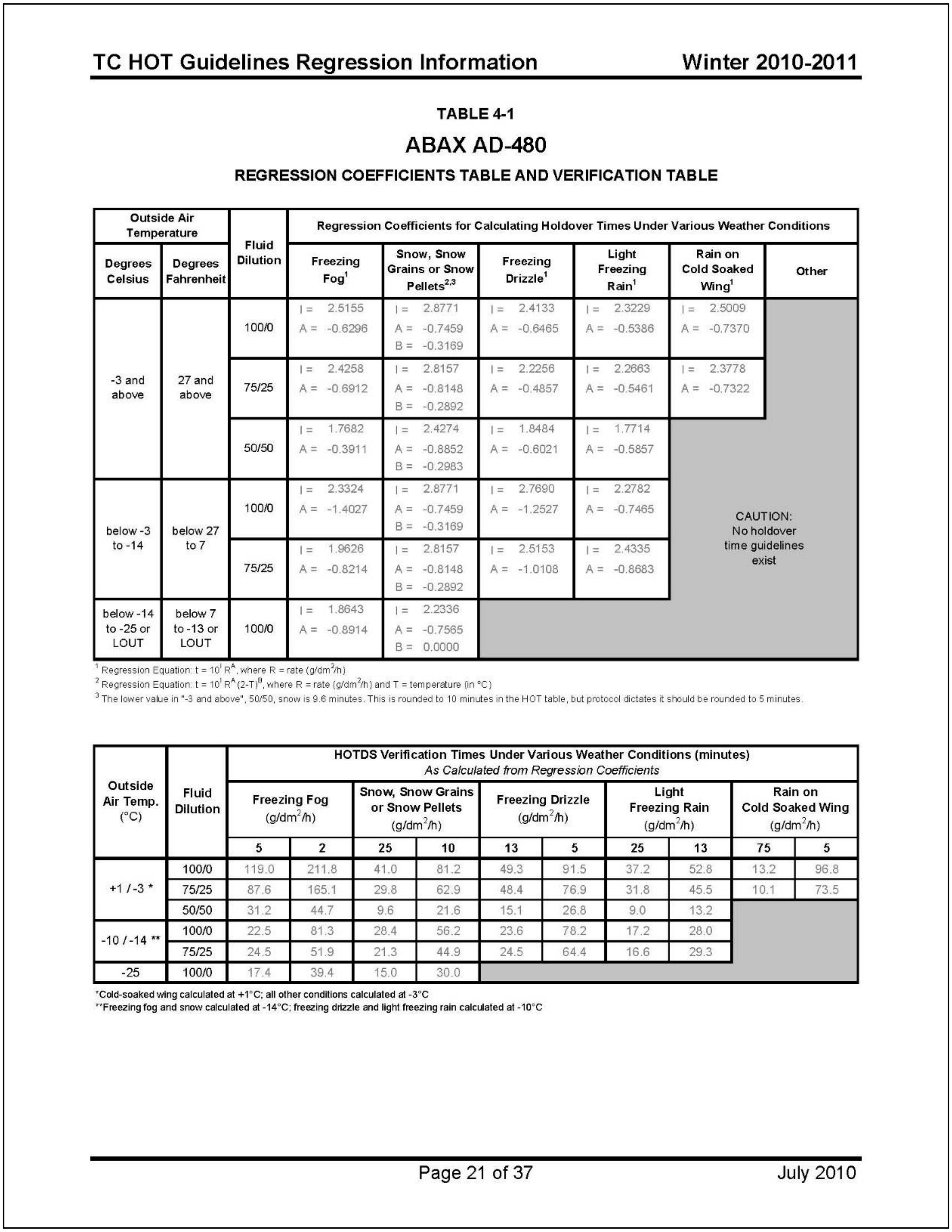

TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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: $t = 10^{I} R^{A} (2-T)^{B}$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C

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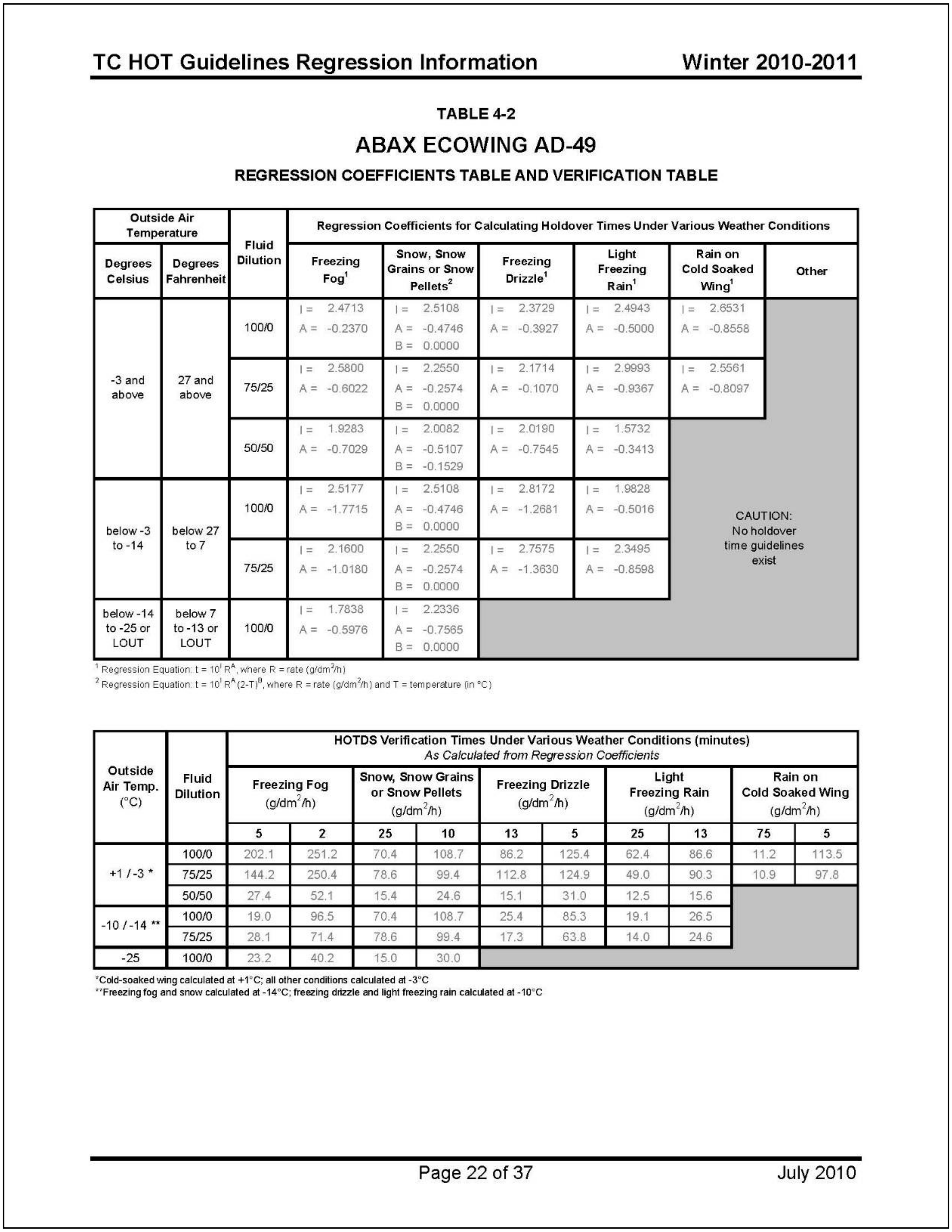


TABLE 4-2

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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist	
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		
		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				

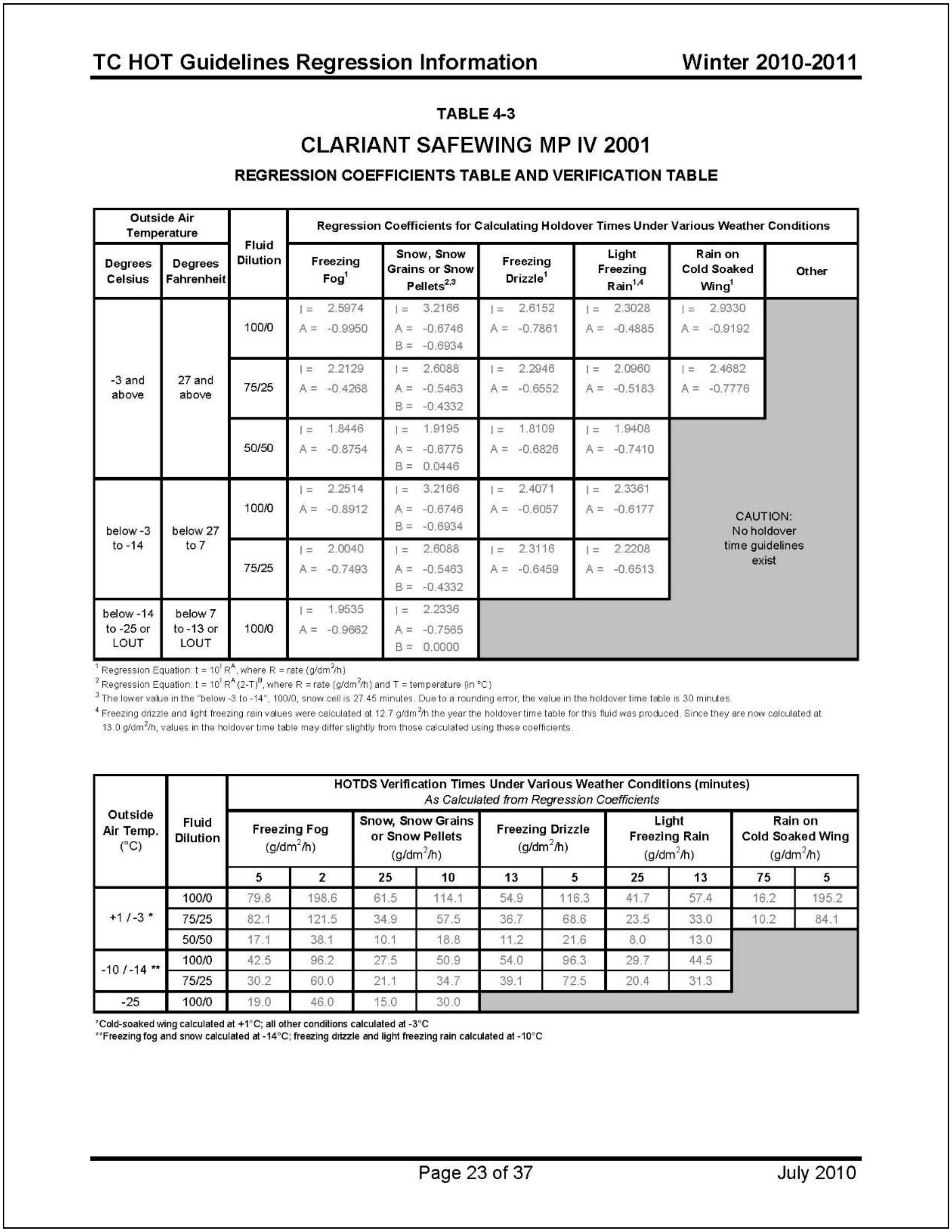
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm^2/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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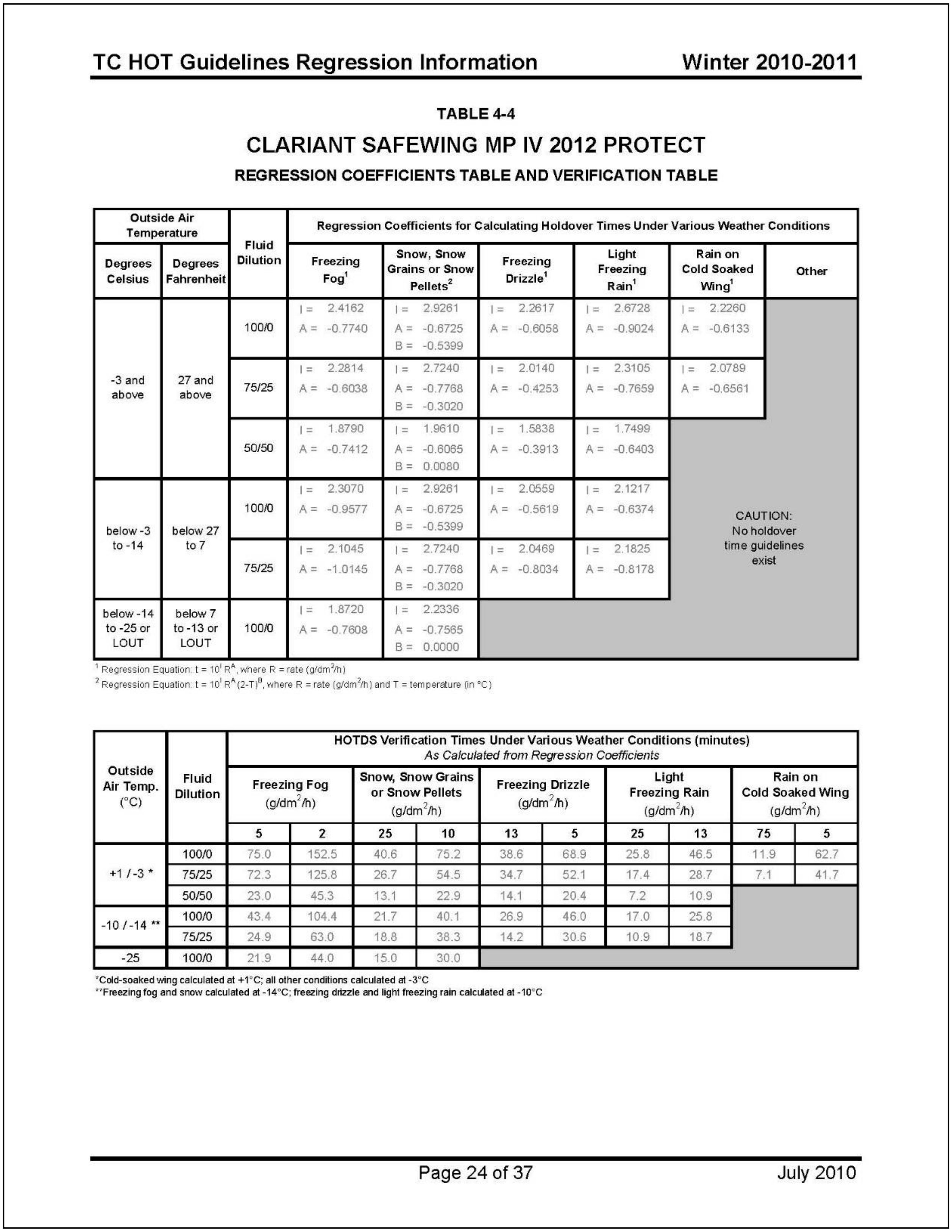

TC HOT Guidelines Regression Information Winter 2010-2011

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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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, Snow Grains or Snow Pellets[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				

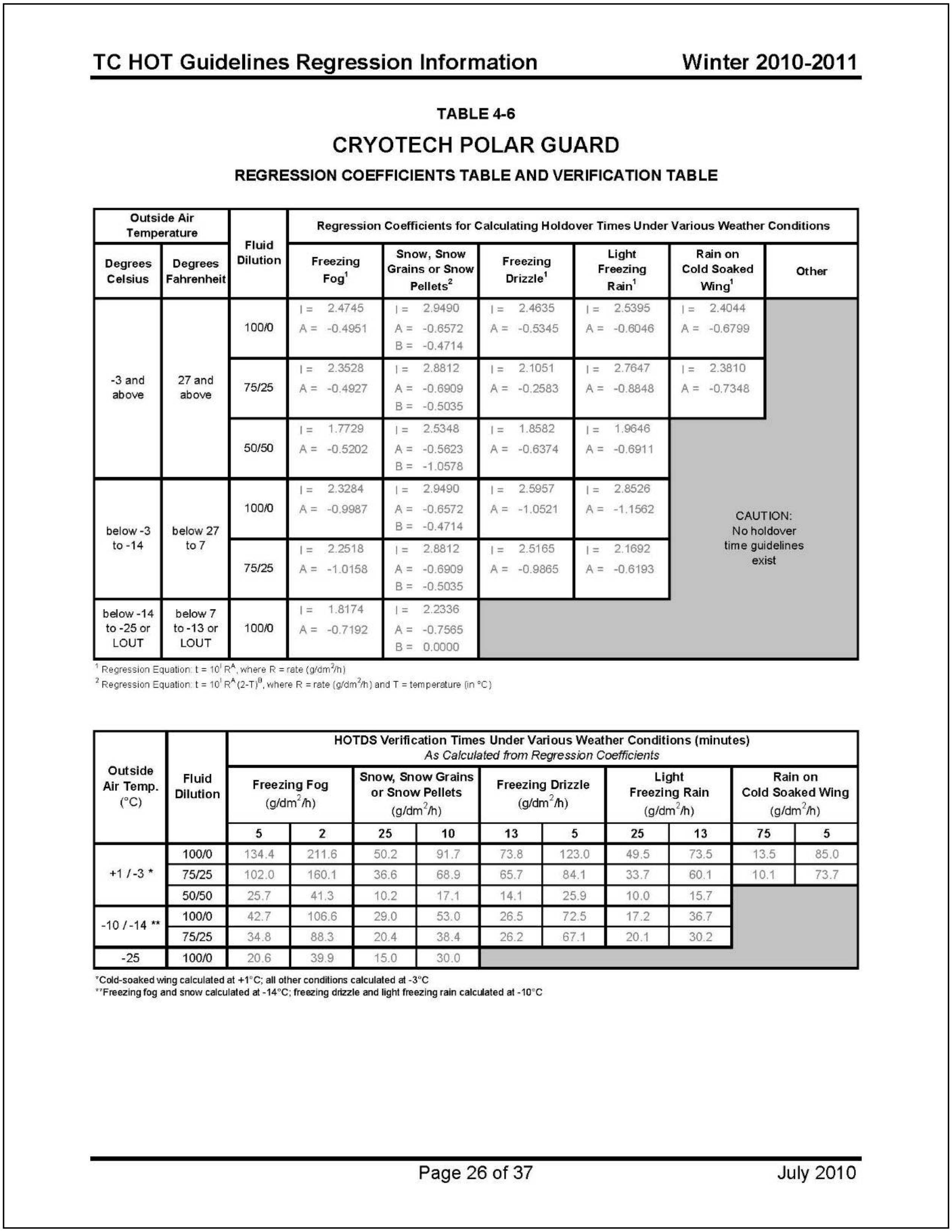
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-6

CRYOTECH POLAR GUARD

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, Snow Grains or Snow Pellets[2]	Freezing Drizzle[1]	Light Freezing Rain[1]	Rain on Cold Soaked Wing[1]	Other
-3 and above	27 and above	100/0	I = 2.4745 A = -0.4951	I = 2.9490 A = -0.6572 B = -0.4714	I = 2.4635 A = -0.5345	I = 2.5395 A = -0.6046	I = 2.4044 A = -0.6799	
		75/25	I = 2.3528 A = -0.4927	I = 2.8812 A = -0.6909 B = -0.5035	I = 2.1051 A = -0.2583	I = 2.7647 A = -0.8848	I = 2.3810 A = -0.7348	
		50/50	I = 1.7729 A = -0.5202	I = 2.5348 A = -0.5623 B = -1.0578	I = 1.8582 A = -0.6374	I = 1.9646 A = -0.6911		
below -3 to -14	below 27 to 7	100/0	I = 2.3284 A = -0.9987	I = 2.9490 A = -0.6572 B = -0.4714	I = 2.5957 A = -1.0521	I = 2.8526 A = -1.1562	CAUTION: No holdover time guidelines exist	
		75/25	I = 2.2518 A = -1.0158	I = 2.8812 A = -0.6909 B = -0.5035	I = 2.5165 A = -0.9865	I = 2.1692 A = -0.6193		
below -14 to -25 or LOUT	below 7 to -13 or LOUT	100/0	I = 1.8174 A = -0.7192	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)

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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on Cold Soaked Wing (g/dm^2/h)	
		5	**2**	**25**	**10**	**13**	**5**	**25**	**13**	**75**	**5**
+1 / -3 *	100/0	134.4	211.6	50.2	91.7	73.8	123.0	49.5	73.5	13.5	85.0
	75/25	102.0	160.1	36.6	68.9	65.7	84.1	33.7	60.1	10.1	73.7
	50/50	25.7	41.3	10.2	17.1	14.1	25.9	10.0	15.7		
-10 / -14 **	100/0	42.7	106.6	29.0	53.0	26.5	72.5	17.2	36.7		
	75/25	34.8	88.3	20.4	38.4	26.2	67.1	20.1	30.2		
-25	100/0	20.6	39.9	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 light freezing rain calculated at -10°C

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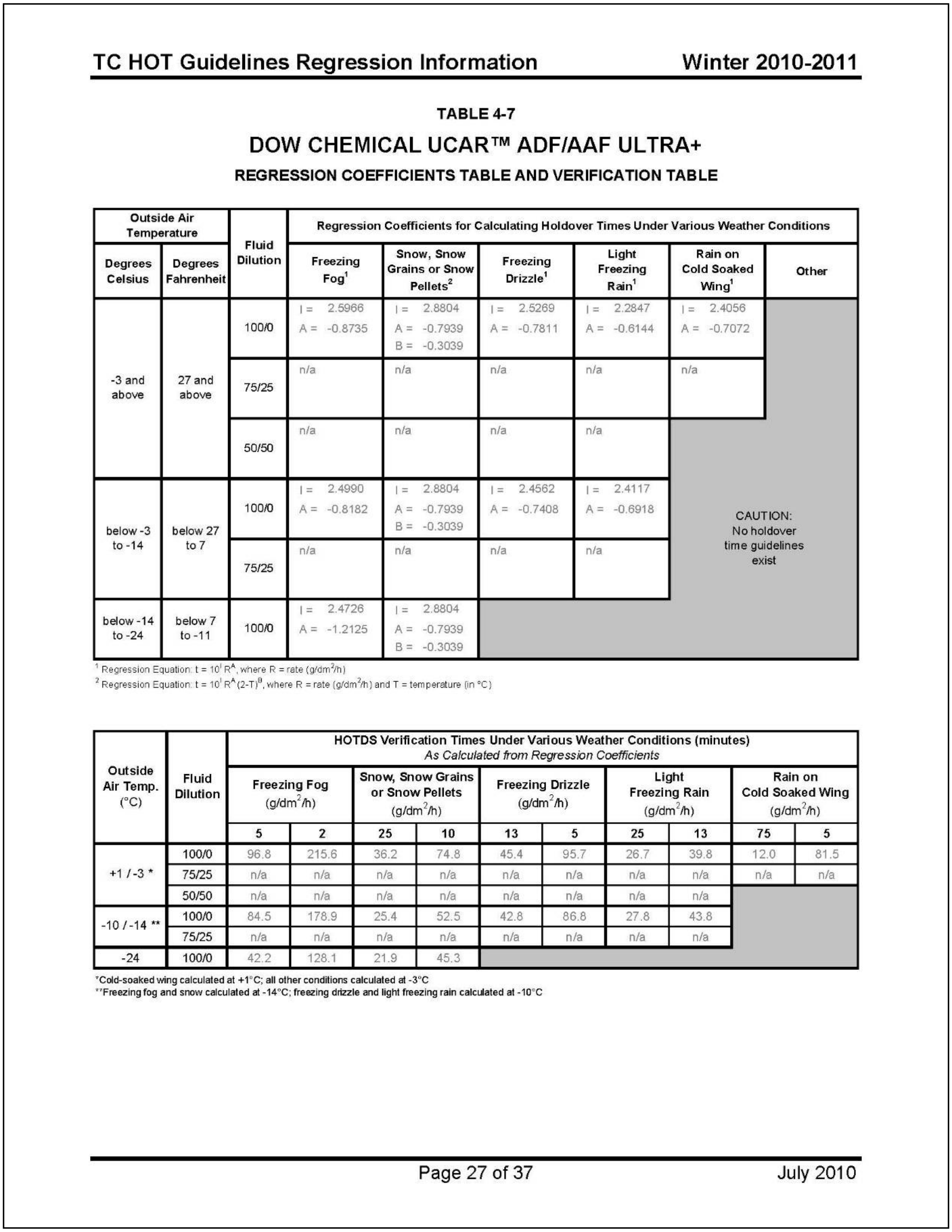


TABLE 4-7

DOW CHEMICAL 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, Snow Grains or Snow Pellets[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 -24	below 7 to -11	100/0	I = 2.4726 A = -1.2125	I = 2.8804 A = -0.7939 B = -0.3039				

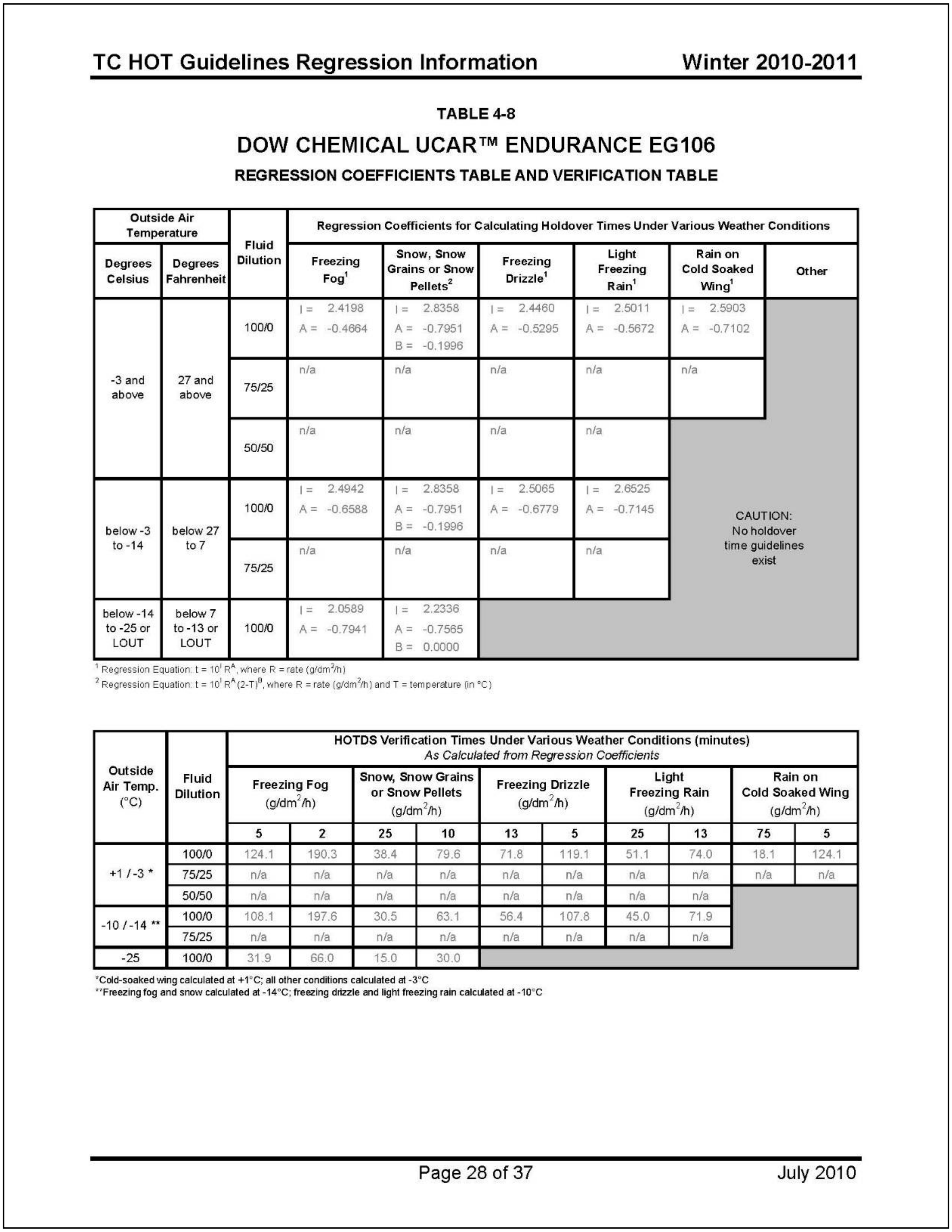
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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		
-24	100/0	42.2	128.1	21.9	45.3						

*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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-8

DOW CHEMICAL 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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^{I} R^{A} (2-T)^{B}$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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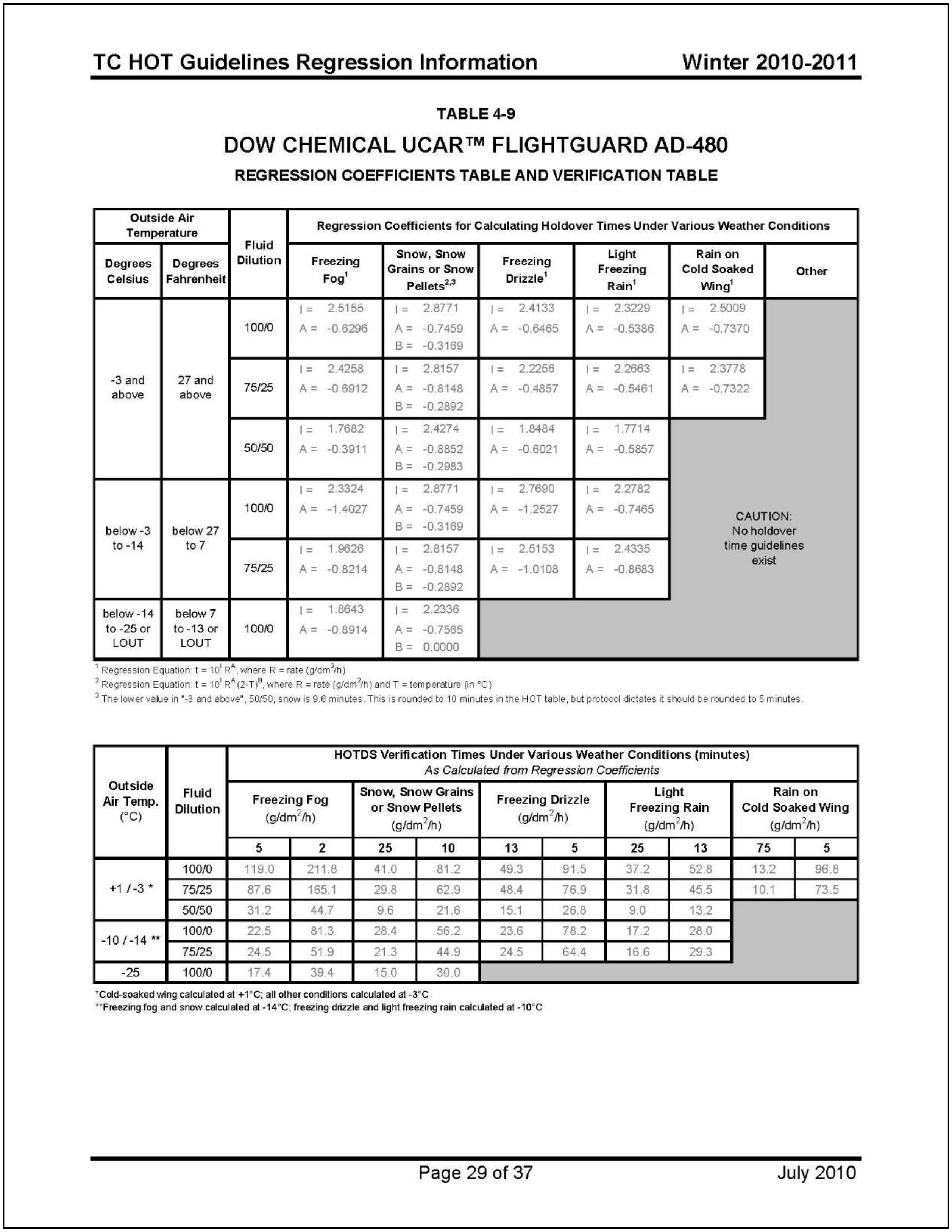

TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-9

DOW CHEMICAL 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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist
		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		
		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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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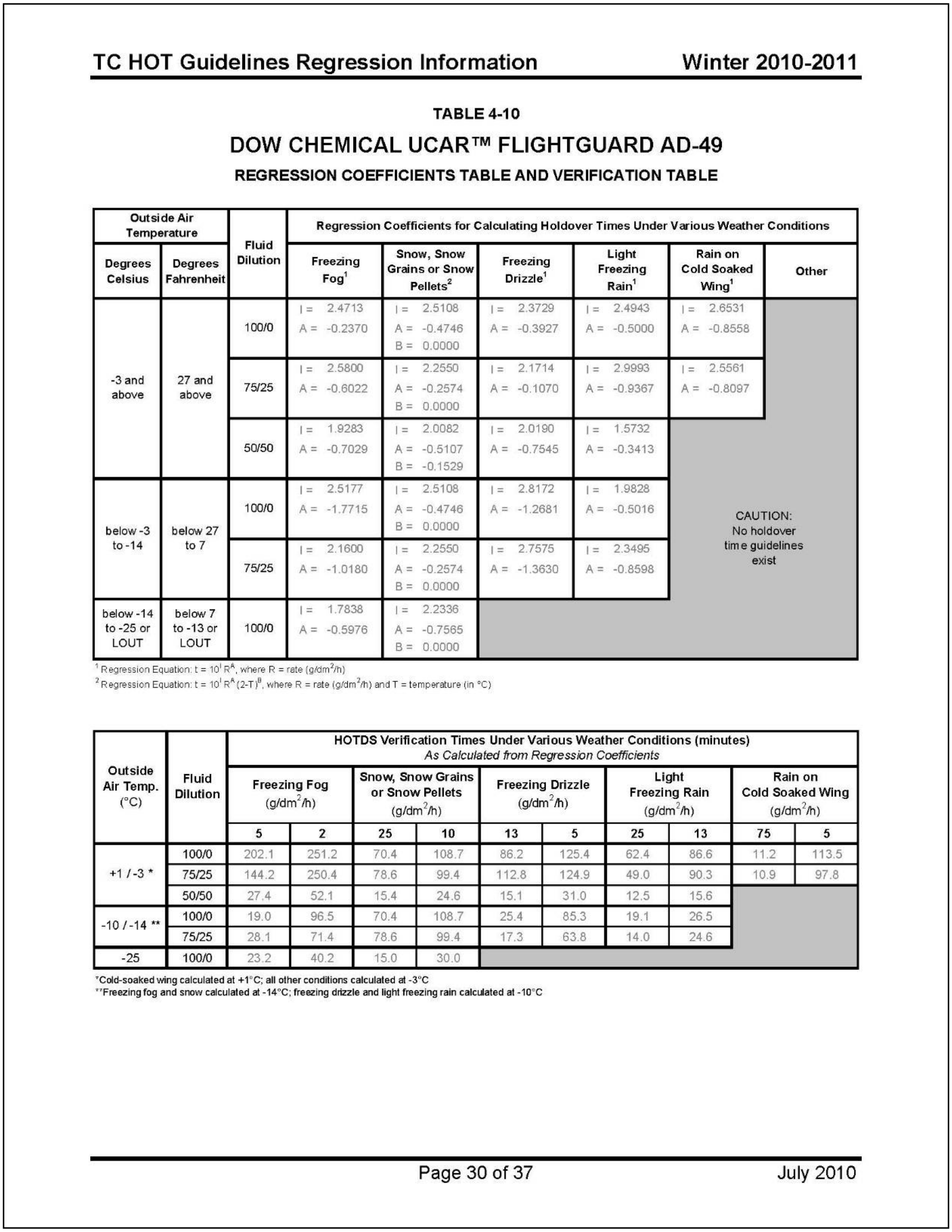


TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-10

DOW CHEMICAL UCAR™ FLIGHTGUARD 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, Snow Grains or Snow Pellets[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				

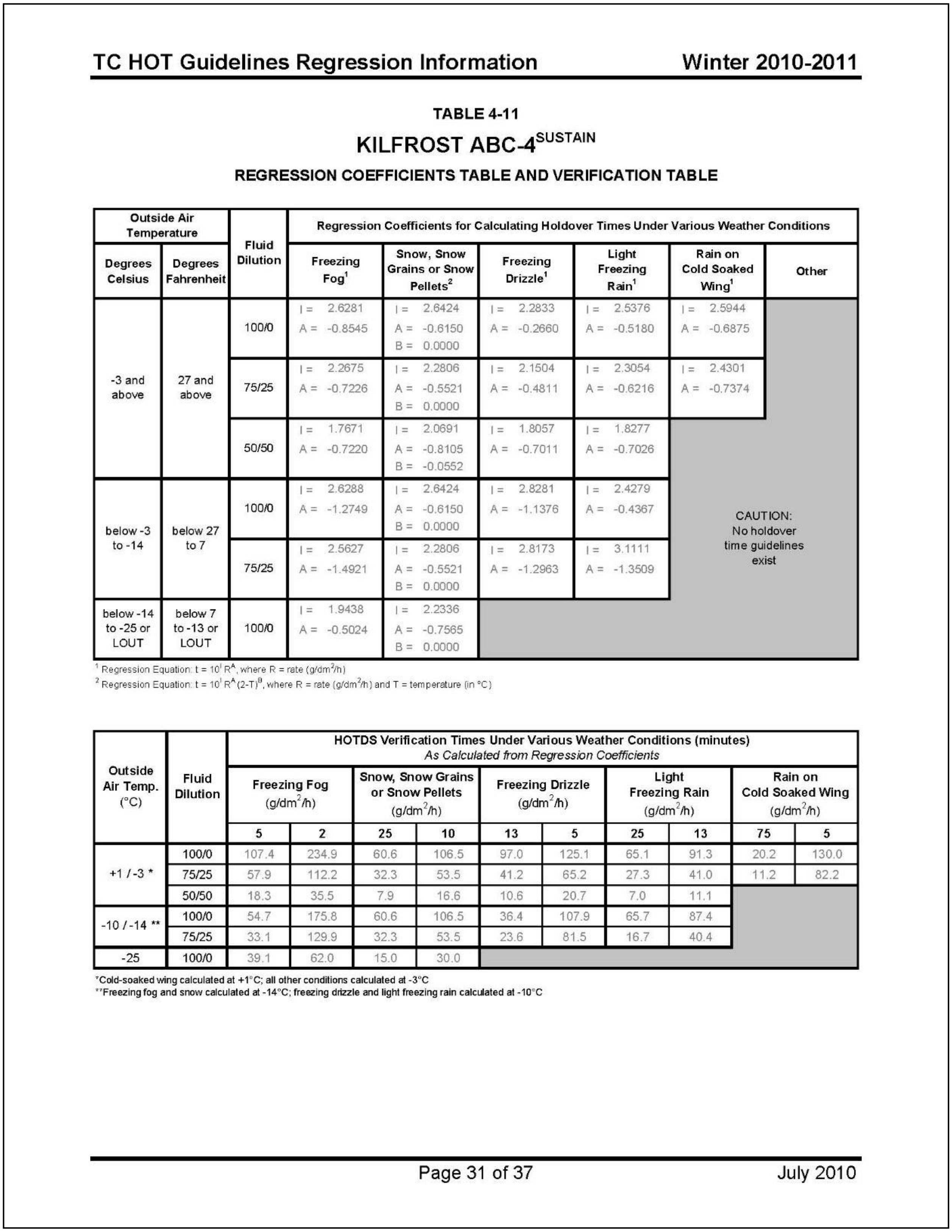
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-11

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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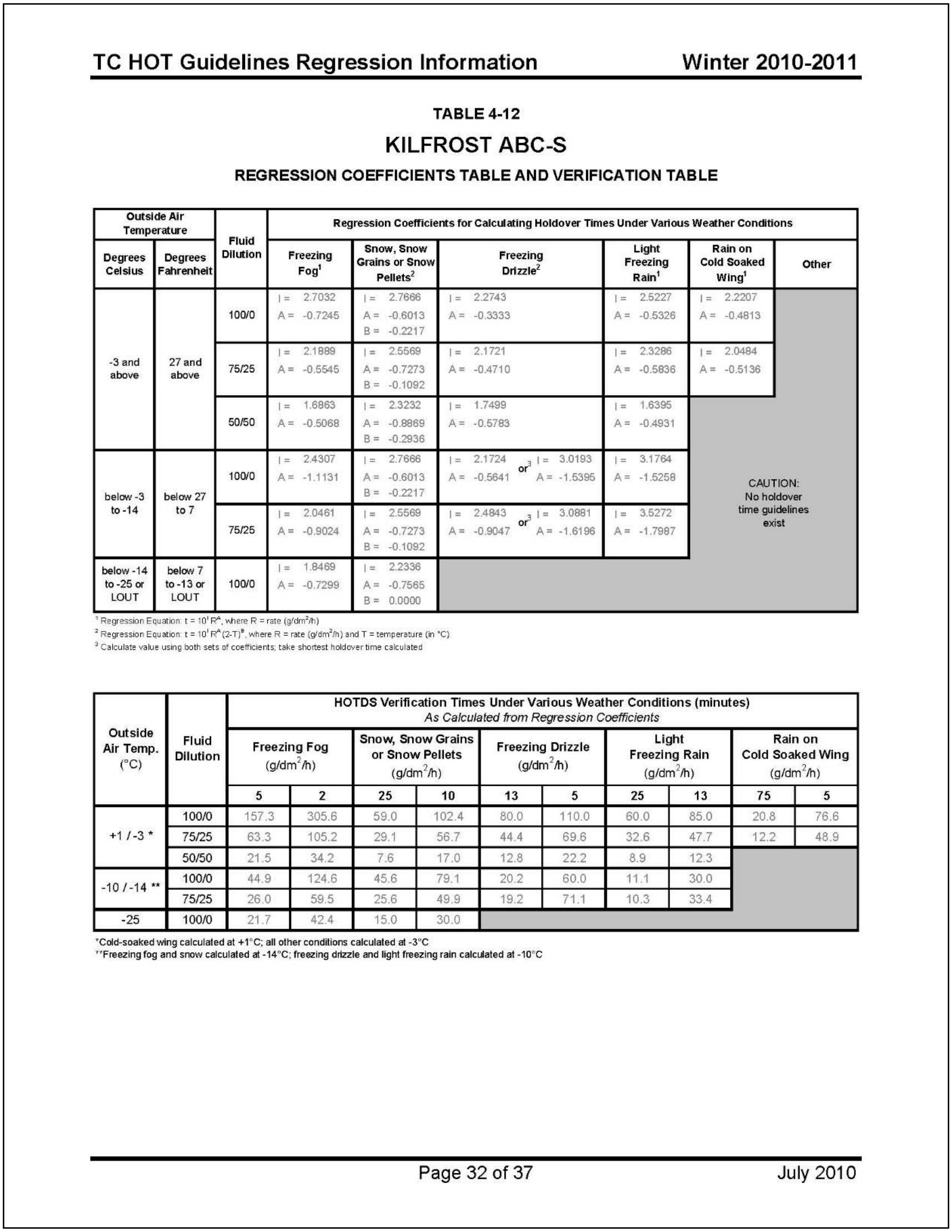

TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-12

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, Snow Grains or Snow Pellets[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: $t = 10^{I} R^{A} (2-T)^{B}$, 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, Snow Grains or Snow Pellets $(g/dm^2/h)$		Freezing Drizzle $(g/dm^2/h)$		Light Freezing Rain $(g/dm^2/h)$		Rain on 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 light freezing rain calculated at -10°C

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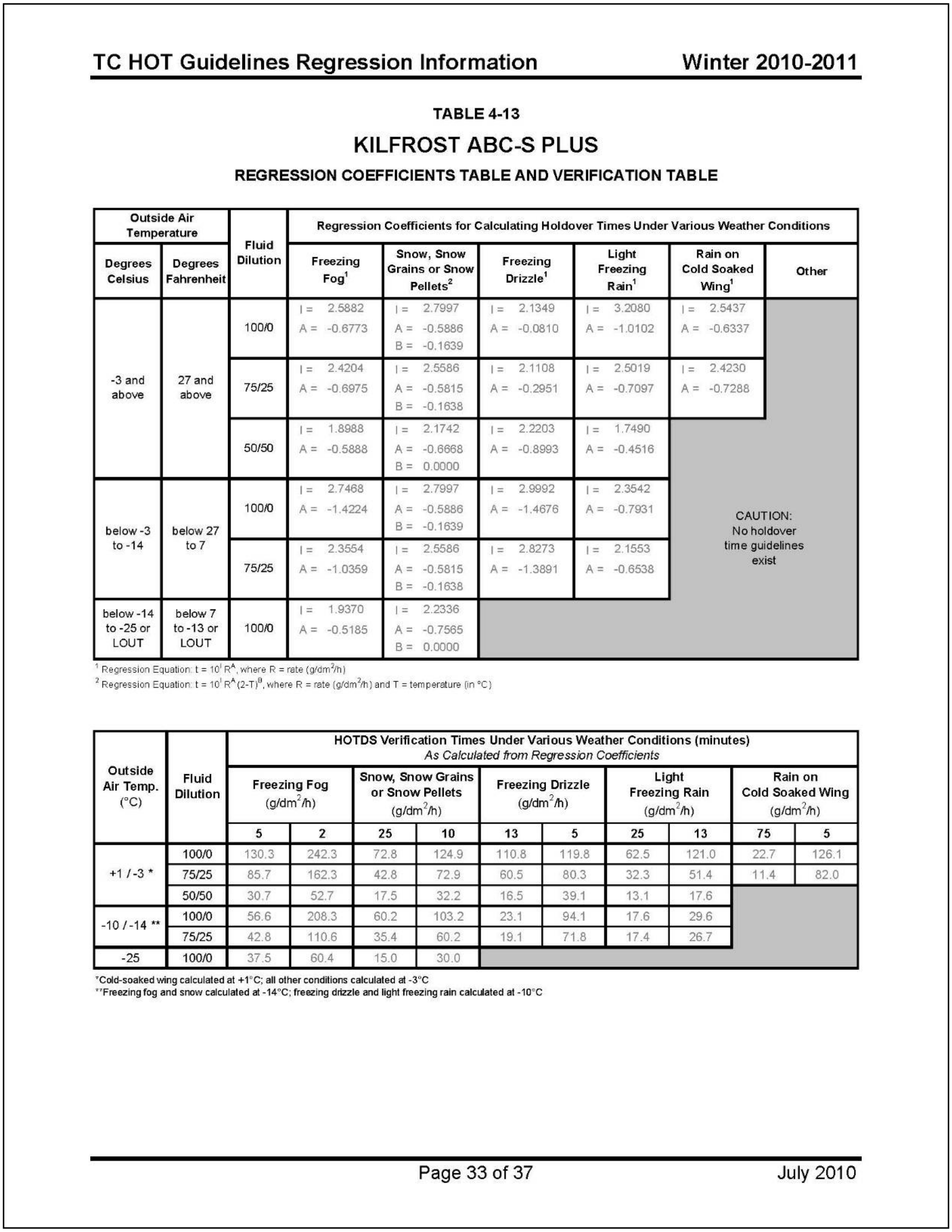


TC HOT Guidelines Regression Information **Winter 2010-2011**

TABLE 4-13

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, Snow Grains or Snow Pellets^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	CAUTION: No holdover time guidelines exist
		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		
		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: $t = 10^I R^A (2-T)^B$, 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, Snow Grains or Snow Pellets (g/dm^2/h)		Freezing Drizzle (g/dm^2/h)		Light Freezing Rain (g/dm^2/h)		Rain on 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 light freezing rain calculated at -10°C

TC HOT Guidelines Regression Information **Winter 2010-2011**

TABLE 4-14

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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist	
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		
		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				

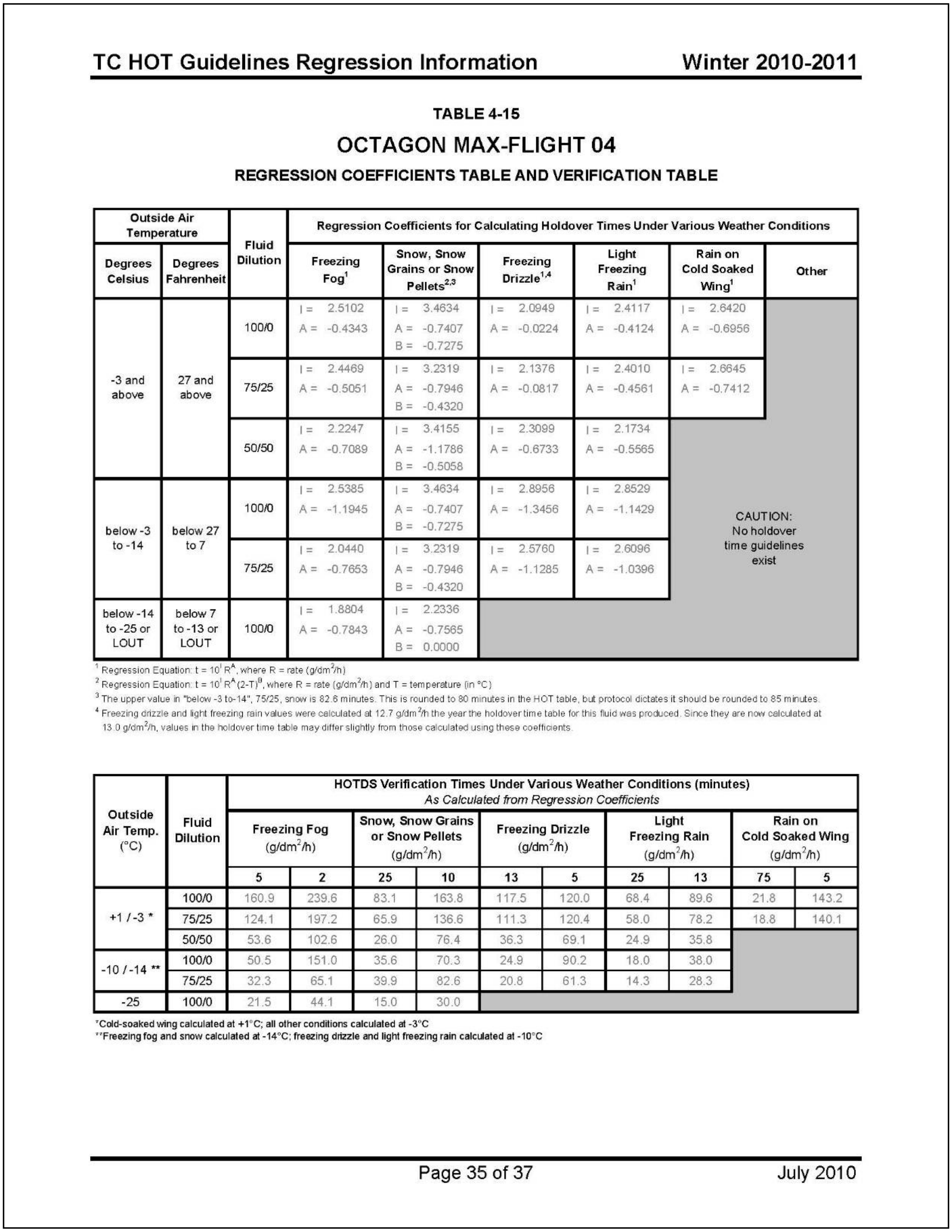
[1] Regression Equation: $t = 10^I R^A$, where R = rate (g/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C



TC HOT Guidelines Regression Information　　Winter 2010-2011

TABLE 4-15

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, Snow Grains or Snow Pellets[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/dm²/h)

[2] Regression Equation: $t = 10^{I} R^{A}(2-T)^{B}$, where R = rate (g/dm²/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/dm²/h the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 g/dm²/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/dm²/h)		**Snow, Snow Grains or Snow Pellets** (g/dm²/h)		**Freezing Drizzle** (g/dm²/h)		**Light Freezing Rain** (g/dm²/h)		**Rain on Cold Soaked Wing** (g/dm²/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 light freezing rain calculated at -10°C

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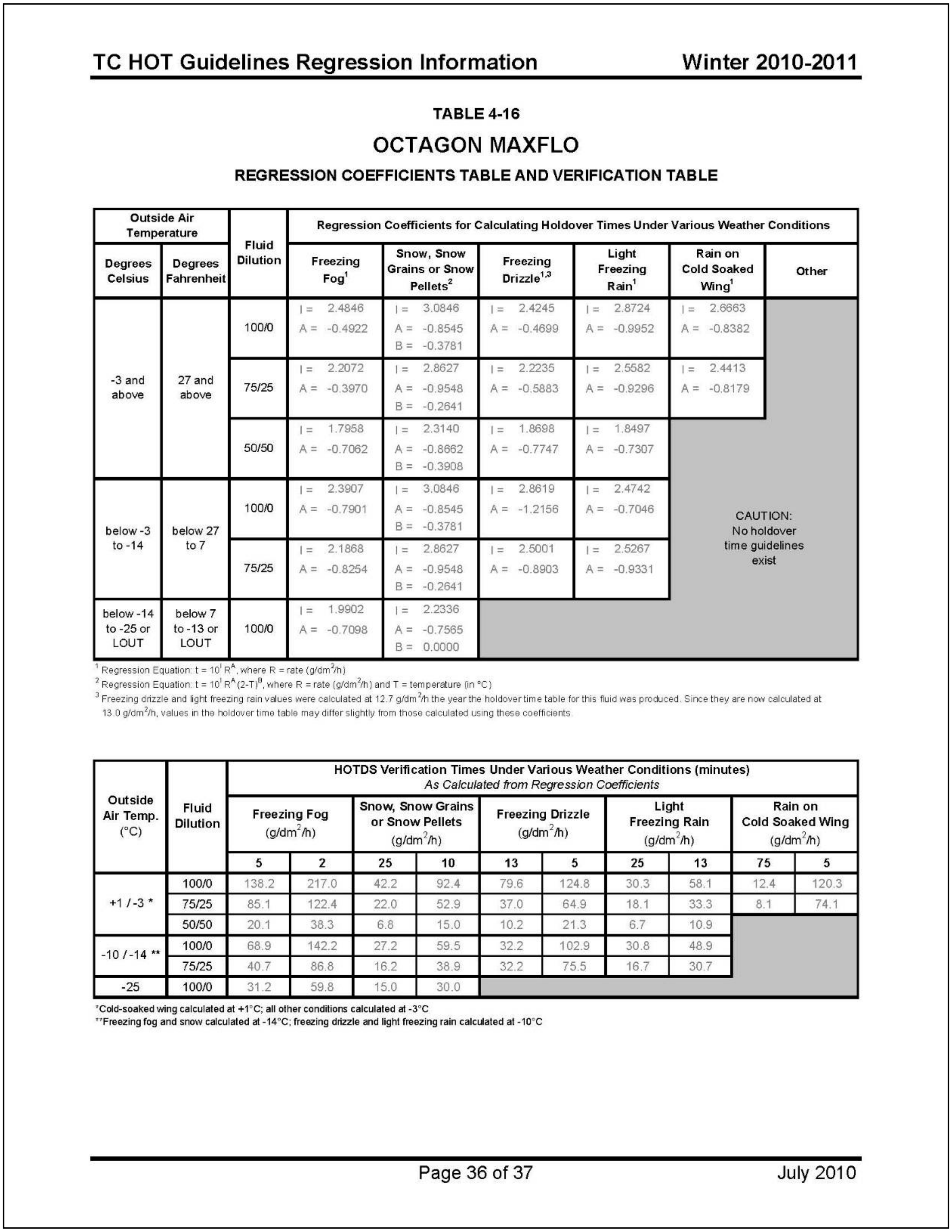

TC HOT Guidelines Regression Information Winter 2010-2011

TABLE 4-16

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, Snow Grains or Snow Pellets[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	CAUTION: No holdover time guidelines exist
		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		
		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/dm²/h)

[2] Regression Equation: $t = 10^I R^A (2-T)^B$, where R = rate (g/dm²/h) and T = temperature (in °C)

[3] Freezing drizzle and light freezing rain values were calculated at 12.7 g/dm²/h the year the holdover time table for this fluid was produced. Since they are now calculated at 13.0 g/dm²/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/dm²/h)		Snow, Snow Grains or Snow Pellets (g/dm²/h)		Freezing Drizzle (g/dm²/h)		Light Freezing Rain (g/dm²/h)		Rain on Cold Soaked Wing (g/dm²/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 light freezing rain calculated at -10°C

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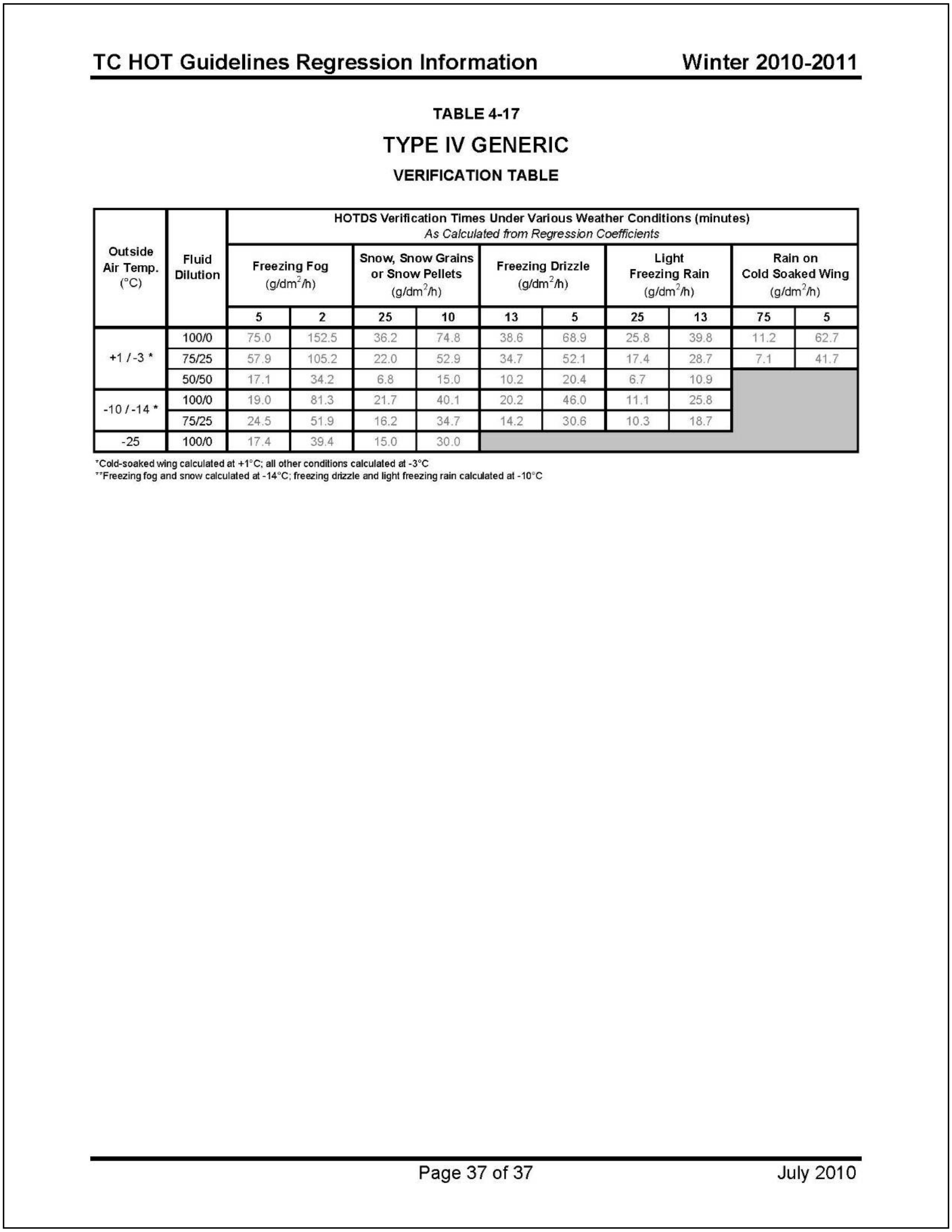

TABLE 4-17

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, Snow Grains or Snow Pellets ($g/dm^2/h$)		Freezing Drizzle ($g/dm^2/h$)		Light Freezing Rain ($g/dm^2/h$)		Rain on 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	41.7
	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 light freezing rain calculated at -10°C

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APPENDIX C

CALCULATION OF REGRESSION COEFFICIENTS FOR TYPE I HOLDOVER TIMES ON COMPOSITE SURFACES IN FREEZING PRECIPITATION CONDITIONS

(ZF, ZD, ZR, CSW)

CALCULATION OF REGRESSION COEFFICIENTS FOR TYPE I HOLDOVER TIMES ON COMPOSITE SURFACES IN FREEZING PRECIPITATION CONDITIONS

(ZF, ZD, ZR, CSW)

Holdover times for Type I fluids on composite surfaces were added to the holdover time (HOT) guidelines in the winter of 2010-11. As a result, regression coefficients needed to be added to the 2010-11 egression publication. The freezing precipitation holdover times for Type I fluids on composite surfaces were not derived directly from regression. Therefore regression coefficients needed to be calculated from the published values. The tables in this section provide the data that was used to complete the regressions and the resulting regression coefficients.

Table C-1: Data Points (Freezing Fog)

Data Point #	Rate of Precip. (g/dm²/h)	Temp (°C)	Fail Time (min)	Log Fail	Log Rate
1	5.0	-3	9.0	0.95	0.70
2	2.0	-3	16.0	1.20	0.30
3	5.0	-6	6.0	0.78	0.70
4	2.0	-6	8.0	0.90	0.30
5	5.0	-10	4.0	0.60	0.70
6	2.0	-10	8.0	0.90	0.30
7	5.0	-25	4.0	0.60	0.70
8	2.0	-25	7.0	0.85	0.30

Table C-2: Summary of Coefficients (Freezing Fog)

Fluid	Temp	r^2	Intercept (I)	Rate Coefficient (A)	Total Pts.
Type I (Composite)	-3°C	100%	1.3931	-0.6279	2
Type I (Composite)	-6°C	100%	0.9976	-0.3140	2
Type I (Composite)	-10°C	100%	1.1308	-0.7565	2
Type I (Composite)	-25°C	100%	1.0289	-0.6107	2

Table C-3: Data Points (Freezing Drizzle)

Data Point #	Rate of Precip. (g/dm²/h)	Temp (°C)	Fail Time (min)	Log Fail	Log Rate
1	13.0	-3	8.0	0.90	1.11
2	5.0	-3	13.0	1.11	0.70
3	13.0	-6	5.0	0.70	1.11
4	5.0	-6	9.0	0.95	0.70
5	13.0	-10	4.0	0.60	1.11
6	5.0	-10	7.0	0.85	0.70

Table C-4: Summary of Coefficients (Freezing Drizzle)

Fluid	Temp	r^2	Intercept (I)	Rate Coefficient (A)	Total Pts.
Type I (Composite)	-3°C	100%	1.4691	-0.5081	2
Type I (Composite)	-6°C	100%	1.3842	-0.6152	2
Type I (Composite)	-10°C	100%	1.2545	-0.5857	2

Table C-5: Data Points (Light Freezing Rain)

Data Point #	Rate of Precip. (g/dm²/h)	Temp (°C)	Fail Time (min)	Log Fail	Log Rate
1	25.0	-3	4.0	0.60	1.40
2	13.0	-3	6.0	0.78	1.11
3	25.0	-6	4.0	0.60	1.40
4	13.0	-6	6.0	0.78	1.11
5	25.0	-10	2.0	0.30	1.40
6	13.0	-10	5.0	0.70	1.11

Table C-6: Summary of Coefficients (Light Freezing Rain)

Fluid	Temp	r^2	Intercept (I)	Rate Coefficient (A)	Total Pts.
Type I (Composite)	-3°C	100%	1.4688	-0.6200	2
Type I (Composite)	-6°C	100%	1.4688	-0.6200	2
Type I (Composite)	-10°C	100%	2.2598	-1.4012	2

Table C-7: Data Points (Rain on Cold Soaked Wing)

Data Point #	Rate of Precip. ($g/dm^2/h$)	Temp (°C)	Fail Time (min)	Log Fail	Log Rate
1	75.0	1	1.0	0.00	1.88
2	5.0	1	5.0	0.70	0.70

Table C-8: Summary of Coefficients (Rain on Cold Soaked Wing)

Fluid	Temp	r^2	Intercept (I)	Rate Coefficient (A)	Total Pts.
Type I (Composite)	+1°C	100%	1.1144	-0.5943	2

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