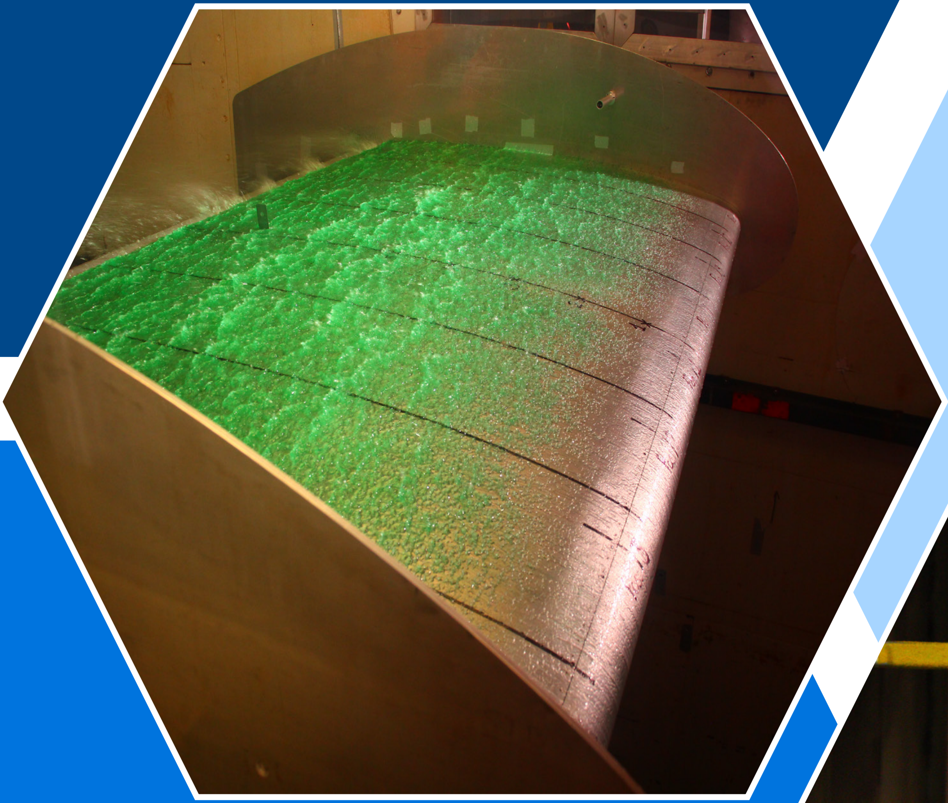


TP 15497E
Final Version 1.0
October 2021

WIND TUNNEL TRIALS TO SUPPORT FURTHER DEVELOPMENT OF ICE PELLET ALLOWANCE TIMES: WINTER 2020-21

Prepared for:

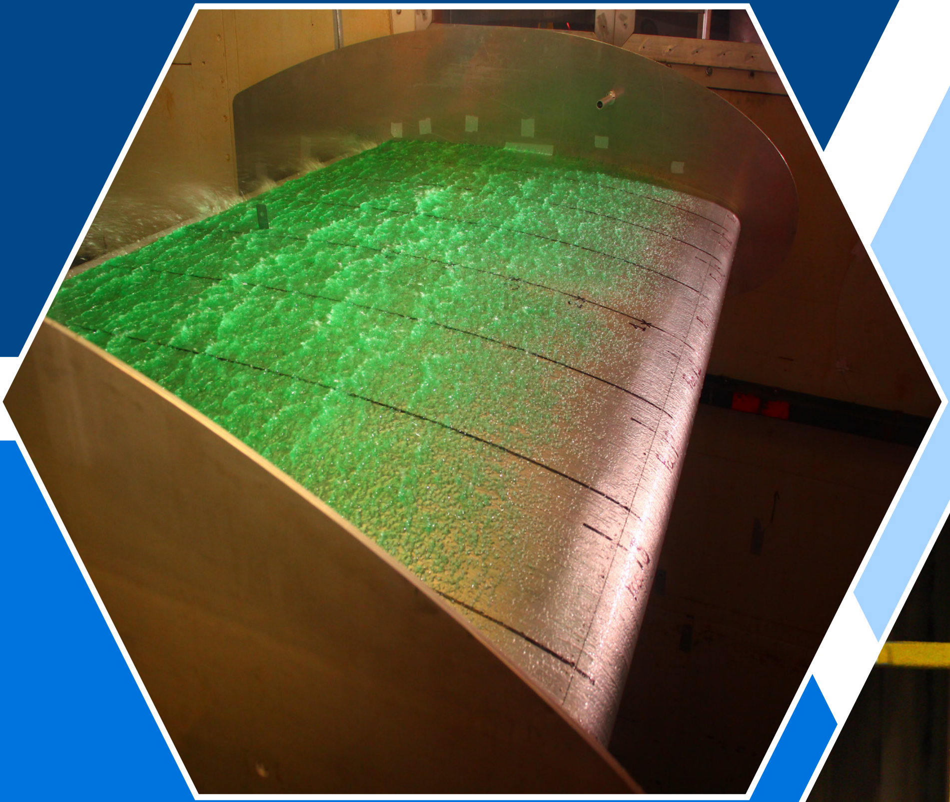
Transport Canada
Innovation Centre

In cooperation with:

Federal Aviation Administration
William J. Hughes Technical Center

Transport Canada
Civil Aviation

Federal Aviation Administration
Flight Standards – Air Carrier Operations



TP 15497E
Final Version 1.0
October 2021

WIND TUNNEL TRIALS TO SUPPORT FURTHER DEVELOPMENT OF ICE PELLET ALLOWANCE TIMES: WINTER 2020-21

Prepared by

Marco Ruggi

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Jul 21, 2022

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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 2021.
It has been published as Final Version 1.0 in July 2022.

PREFACE

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

- To develop holdover time data for all new de/anti-icing fluids;
- To conduct testing to determine holdover times for Type II, III, and IV fluids in snow at temperatures below -14°C;
- To conduct additional testing and analysis to evaluate and/or determine appropriate holdover times for Type I fluids in snow at temperatures below -14°C;
- To evaluate and develop the use of artificial snow machines for holdover time development;
- To conduct wind tunnel testing with a thin high performance wing model to support the development of guidance material for operating in ice pellet conditions;
- To finalize the research for the development of degree-specific snow holdover time data;
- To study and support the interpretation of METAR reported weather for determining holdover time table guidance;
- To conduct general and exploratory de/anti-icing research;
- To finalize the publication and delivery of current and historical reports;
- To update the regression information report to reflect changes made to the holdover time guidelines; and
- To update the holdover time guidance materials for annual publication by Transport Canada and the Federal Aviation Administration.

Some project timelines were impacted due to the COVID-19 pandemic. The details of these impacts are described in the individual reports, if applicable. The research activities of the program conducted on behalf of Transport Canada during the winter of 2020-21 are documented in four reports. The titles of the reports are as follows:

- TP 15494E Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2020-21 Winter;
- TP 15495E Regression Coefficients and Equations Used to Develop the Winter 2021-22 Aircraft Ground Deicing Holdover Time Tables;
- TP 15496E Aircraft Ground Icing General Research Activities During the 2020-21 Winter; and
- TP 15497E Wind Tunnel Trials to Support Further Development of Ice Pellet Allowance Times: Winter 2020-21.

In addition, the following interim report is being prepared:

- *Artificial Snow Research Activities for the 2020-21 Winter*.

This report, TP 15497E, has the following objective:

- To conduct research in the National Research Council Canada Icing Wind Tunnel with a thin high-performance wing section to further support and develop the anti-icing fluid Ice Pellet Allowance Times.

This objective was met by conducting a series of full-scale tests using a thin high-performance wing model in the National Research Council Canada Icing Wind Tunnel with the cooperation of Transport Canada and the Federal Aviation Administration.

PROGRAM ACKNOWLEDGEMENTS

This multi-year research program has been funded by the Transport Canada Innovation Centre, with support from the Federal Aviation Administration William J. Hughes Technical Center, Transport Canada Civil Aviation, and Federal Aviation Administration Flight Standards – Air Carrier Operations. This program could not have been accomplished without the participation of many organizations. APS Aviation Inc. would therefore like to thank Transport Canada, the Federal Aviation Administration, National Research Council Canada, and supporting members of the SAE International G-12 Aircraft Ground Deicing Committees.

APS Aviation Inc. would also like to acknowledge the dedication of the research team, whose performance was crucial to the acquisition of hard data, completion of data analysis, and preparation of reports. This includes the following people: Brandon Auclair, David Beals, Steven Baker, Stephanie Bendickson, Benjamin Bernier, Chloë Bernier, Christopher D'Avirro, John D'Avirro, Peter Dawson, Jaycee Ewald, Noemie Gokhool, Benjamin Guthrie, Peter Kitchener, Diana Lalla, Shahdad Movaffagh, Dany Posteraro, Annaelle Reuveni, Marco Ruggi, Javad Safari, Alexa-Kiran Sareen-Diacoumacos, Niroshaan Sivarajah, James Smyth, Saba Tariq, Charles Wilson, Ian Wittmeyer, and David Youssef.

Special thanks are extended to Antoine Lacroix, Yvan Chabot, Warren Underwood, and Charles J. Enders, who on behalf of Transport Canada and the Federal Aviation Administration, have participated, contributed, and provided guidance in the preparation of these documents.

PROJECT ACKNOWLEDGEMENTS

APS Aviation Inc. would like to acknowledge the team at National Research Council Canada who operate the icing wind tunnel, especially Catherine Clark for engineering support and aerodynamic expertise. APS Aviation Inc. would like to acknowledge Andy Broeren of National Aeronautics and Space Administration whose engineering support and aerodynamic expertise have been crucial to the development of wind tunnel testing protocols used today. APS Aviation Inc. would also like to acknowledge the fluid manufacturers who have provided samples over the years to support the wind tunnel testing.

Transport Canada Transports Canada

PUBLICATION DATA FORM

1. Transport Canada Publication No.
TP 15497E

2. Project No.
B14W

3. Recipient's Catalogue No.

4. Title and Subtitle
Wind Tunnel Trials to Support Further Development of Ice Pellet Allowance Times: Winter 2020-21

5. Publication Date
October 2021

6. Performing Organization Document No.
300293

7. Author(s)
Marco Ruggi

8. Transport Canada File No.
2450-BP-14

9. Performing Organization Name and Address
APS Aviation Inc.
6700 Côte-de-Liesse Rd., Suite 102
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10. PWGSC File No.
TOR-7-40103

11. PWGSC or Transport Canada Contract No.
T8156-170044/001/TOR

12. Sponsoring Agency Name and Address
Transport Canada
Innovation Centre
330 Sparks St., 18th Floor
Ottawa, Ontario, K1A 0N5

13. Type of Publication and Period Covered
Final

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

Several research reports for testing of de/anti-icing technologies were produced for previous winters on behalf of Transport Canada (TC). These are available from the TC Innovation Centre. 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

As part of a larger research program examining de/anti-icing fluid flow-off during simulated aircraft takeoff, APS Aviation Inc. conducted a series of full-scale wing tests in the National Research Council Canada Icing Wind Tunnel to determine the flow-off characteristics of anti-icing fluid with and without mixed precipitation conditions with ice pellets.

A wind tunnel testing program was developed for the winter of 2020-21 with the primary objectives of conducting aerodynamic testing to substantiate the current Type IV fluid Ice Pellet Allowance Times with new fluids, and to extend the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol (EG) based fluids.

The wind tunnel testing conducted during the winter of 2020-21 validated the current Type IV allowance times for use with the new-to-market fluid: AllClear ClearWing EG. Validation testing for Cryotech Polar Guard Xtend is considered incomplete and more testing is recommended.

Type IV EG fluid testing and an analysis of historical data supported longer allowance times specific to Type IV EG fluids, and a new separate EG Ice Pellet Allowance Time Table will be published for the winter 2021-22 Holdover Time Guidelines.

The proposed changes resulted in three separate allowance tables for Type III, and the newly separated Type IV EG, and Type IV propylene glycol fluids. The notes in the respective tables were updated to reflect the latest format and content changes. In addition, a column specifying the applicable METAR codes for each condition was included in the three tables.

17. Key Words
Ice Pellet, Allowance Time, High Speed Rotation, Low Speed Rotation, Type II, Type III, Type IV, Fluid Adherence, Fluid Flow-Off, Wind Tunnel, Icing Wind Tunnel, Wing Aerodynamics

18. Distribution Statement
Available from the Transport Canada Innovation Centre

19. Security Classification (of this publication)
Unclassified

20. Security Classification (of this page)
Unclassified

21. Declassification (date)

22. No. of Pages
xvi, 82 apps

23. Price

CDT/TDC 79-005
Rev. 96

Transports Canada Transport Canada

FORMULE DE DONNÉES POUR PUBLICATION

1. No de la publication de Transports Canada

TP 15497E

2. No de l'étude

B14W

3. No de catalogue du destinataire

4. Titre et sous-titre

Wind Tunnel Trials to Support Further Development of Ice Pellet Allowance Times: Winter 2020-21

5. Date de la publication

Octobre 2021

6. No de document de l'organisme exécutant

300293

7. Auteur(s)

Marco Ruggi

8. No de dossier - Transports Canada

2450-BP-14

9. Nom et adresse de l'organisme exécutant

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Montréal (Québec) H4T 2B5

10. No de dossier - TPSGC

TOR-7-40103

11. No de contrat - TPSGC ou Transports Canada

T8156-170044/001/TOR

12. Nom et adresse de l'organisme parrain

Transports Canada
Centre d'innovation
330, rue Sparks, 18ième étage
Ottawa (Ontario) K1A 0N5

13. Genre de publication et période visée

Final

14. Agent de projet

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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 (TC). Ils sont disponibles auprès du Centre d'innovation de TC. De nombreux rapports ont été rédigés dans le cadre du programme de recherche de cet hiver. Leur objet apparaît à l'avant-propos. Ce projet était coparrainé par la Federal Aviation Administration.

16. Résumé

Dans le cadre d'un plus vaste programme de recherche étudiant le ruissellement du liquide de dégivrage et d'antigivrage durant le décollage simulé d'un aéronef, APS Aviation Inc. a mené une série d'essais sur des ailes pleine grandeur dans la soufflerie de givrage du Conseil national de recherches Canada afin de déterminer les caractéristiques de ruissellement du liquide d'antigivrage avec et sans conditions de précipitations mixtes comprenant des granules de glace.

Un programme d'essais en soufflerie a été élaboré pour l'hiver 2020-2021 avec comme principaux objectifs de réaliser des tests aérodynamiques visant à corroborer les marges de tolérance actuelles pour les granules de glace avec de nouveaux liquides de type IV, et d'élargir les marges de tolérance actuelles dans des conditions de granules de glace pour les liquides de type IV à base d'éthylène glycol.

Les essais menés en soufflerie au cours de l'hiver 2020-2021 ont confirmé l'applicabilité des marges de tolérance actuelles des liquides de type IV à un produit nouvellement commercialisé : AllClear ClearWing EG. Les essais de validation pour Cryotech Polar Guard Xtend ont été jugés incomplets; il est donc recommandé de procéder à des évaluations supplémentaires.

Des essais réalisés sur les liquides de type IV à base d'EG (éthylène glycol) et une analyse des données historiques ont étayé l'augmentation des marges de tolérance spécifiques à ces produits. De ce fait, un nouveau tableau des marges de tolérance relatives aux liquides à base d'EG dans des conditions de granules de glace sera publié dans le cadre des lignes directrices sur les durées d'efficacité pour l'hiver 2021-2022.

Les changements proposés ont donné lieu à trois tableaux de marges de tolérance distincts pour les liquides de type III, ainsi que les liquides de type IV à base d'EG et ceux de type IV à base de PG (propylène glycol), dont le traitement a récemment été scindé. Les notes des tableaux respectifs ont été mises à jour pour refléter les dernières modifications apportées au format et au contenu. De plus, une colonne indiquant les codes METAR applicables à chaque condition météorologique a été incluse dans les trois tableaux.

17. Mots clés

Granule de glace, marge de tolérance, rotation à haute vitesse, rotation à basse vitesse, type II, type III, type IV, adhérence de liquide, écoulement de liquide, soufflerie, soufflerie de givrage, aérodynamisme des ailes

18. Diffusion

Disponible auprès du Centre d'innovation de Transports Canada

19. Classification de sécurité (de cette publication)

Non classifiée

20. Classification de sécurité (de cette page)

Non classifiée

21. Déclassification (date)

22. Nombre de pages

xvi, 82 ann.

23. Prix

CDT/TDC 79-005
Rev. 96

EXECUTIVE SUMMARY

Under contract to the Transport Canada (TC) Innovation Centre, with support from the Federal Aviation Administration (FAA) William J. Hughes Technical Center, TC Civil Aviation, and FAA Flight Standards – Air Carrier Operations, APS Aviation Inc. (APS) carried out research in the winter of 2020-21 in support of the aircraft ground icing research program.

As part of a larger research program, APS conducted a series of full-scale wing tests in the National Research Council Canada 3 m x 6 m Icing Wind Tunnel to determine the flow-off characteristics of anti-icing fluid with and without mixed precipitation conditions with ice pellets.

Background and Objective

A wind tunnel testing program was developed for the winter of 2020-21 with the primary objectives of conducting aerodynamic testing to:

- Substantiate the current Type IV fluid Ice Pellet Allowance Times with new fluids using the thin high-performance regional jet (RJ) airfoil and, weather permitting, at temperatures close to the fluid lowest operational use temperature; and
- Extend the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol (EG) fluids using the thin high-performance RJ airfoil.

Conclusions and Recommendations

The wind tunnel testing conducted during the winter of 2020-21 validated the current Type IV allowance times for use with the new-to-market fluid: AllClear ClearWing EG. Validation testing for Cryotech Polar Guard Xtend is considered incomplete and more testing is recommended.

Type IV EG fluid testing and an analysis of historical data supported longer allowance times specific to Type IV EG fluids, and a new separate EG Ice Pellet Allowance Time Table will be published for the winter 2021-22 Holdover Time Guidelines.

The proposed changes resulted in three separate allowance tables for Type III, and the newly separated Type IV EG, and Type IV PG fluids. The notes in the respective tables were updated to reflect the latest format and content changes. In addition, a column specifying the applicable METAR codes for each condition was included in the three tables.

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SOMMAIRE

En vertu d'un contrat avec le Centre d'innovation de Transports Canada (TC) et avec le soutien du William J. Hughes Technical Center de la Federal Aviation Administration (FAA), du département de l'aviation civile de TC, et de la FAA Flight Standards – Air Carrier Operations, APS Aviation Inc. (APS) a mené des essais au cours de l'hiver 2020-2021 dans le cadre d'un programme de recherche sur le givrage d'aéronefs au sol.

Dans le cadre d'un plus vaste programme de recherche, APS Aviation Inc. a mené une série d'essais sur des ailes pleine grandeur dans la soufflerie de givrage de 3 m sur 6 m du Conseil national de recherches Canada afin de déterminer les caractéristiques de ruissellement du liquide d'antigivrage avec et sans conditions de précipitations mixtes comprenant des granules de glace.

Contexte et objectif

Un programme d'essais en soufflerie a été élaboré pour l'hiver 2020-2021 avec comme principaux objectifs de réaliser des tests aérodynamiques visant à :

- Corroborer les marges de tolérance actuelles pour les granules de glace avec de nouveaux liquides de type IV au moyen d'une surface portante haute performance à profil mince d'un avion de transport régional à réaction et, selon les conditions météorologiques, à des températures se rapprochant de la température minimale d'utilisation opérationnelle ; et
- Élargir les marges de tolérance actuelles dans des conditions de granules de glace pour les liquides de type IV à base d'éthylène glycol au moyen d'une surface portante haute performance à profil mince d'un avion de transport régional à réaction.

Conclusions and recommandations

Les essais menés en soufflerie au cours de l'hiver 2020-2021 ont confirmé l'applicabilité des marges de tolérance actuelles des liquides de type IV à un produit nouvellement commercialisé : AllClear ClearWing EG. Les essais de validation pour Cryotech Polar Guard Xtend ont été jugés incomplets; il est donc recommandé de procéder à des évaluations supplémentaires.

Des essais réalisés sur les liquides de type IV à base d'EG (éthylène glycol) et une analyse des données historiques ont étayé l'augmentation des marges de tolérance spécifiques à ces produits. De ce fait, un nouveau tableau des marges de tolérance

relatives aux liquides à base d'EG dans des conditions de granules de glace sera publié dans le cadre des lignes directrices sur les durées d'efficacité pour l'hiver 2021-2022.

Les changements proposés ont donné lieu à trois tableaux de marges de tolérance distincts pour les liquides de type III, ainsi que les liquides de type IV à base d'EG et ceux de type IV à base de PG (propylène glycol), dont le traitement a récemment été scindé. Les notes des tableaux respectifs ont été mises à jour pour refléter les dernières modifications apportées au format et au contenu. De plus, une colonne indiquant les codes METAR applicables à chaque condition météorologique a été incluse dans les trois tableaux.

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GLOSSARY

APS	APS Aviation Inc.
AWG	Aerodynamics Working Group
CCTV	Closed-Circuit Television System
EG	Ethylene Glycol
FAA	Federal Aviation Administration
FPD	Freezing Point Depressant
HOT	Holdover Time
IWT	3 m x 6 m Icing Wind Tunnel
LOUT	Lowest Operational Use Temperature
NRC	National Research Council Canada
OAT	Outside Air Temperature
PG	Propylene Glycol
RJ	Regional Jet
RTD	Resistance Temperature Detector
TC	Transport Canada

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1. INTRODUCTION

Under winter precipitation conditions, aircraft are cleaned prior to takeoff. This is typically done with aircraft ground deicing fluids, which are freezing point depressant (FPD) fluids developed specifically for aircraft use. If required, aircraft are then protected against further accumulation of precipitation by the application of aircraft ground anti-icing fluids, which are also FPD fluids. Most anti-icing fluids contain thickeners to extend protection time.

Prior to the 1990s, aircraft ground de/anti-icing had not been extensively researched. However, following several ground icing related incidents in the late 1980s, an aircraft ground icing research program was initiated by Transport Canada (TC). The objective of the program is to improve knowledge, improve safety, and enhance operational capabilities of aircraft operating in winter precipitation conditions.

Since its inception in the early 1990s, the aircraft ground icing research program has been managed by TC, with the co-operation of the United States Federal Aviation Administration (FAA), the National Research Council Canada (NRC), several major airlines, and de/anti-icing fluid manufacturers.

There is still an incomplete understanding of some of the hazards related to aircraft ground icing. As a result, the aircraft ground icing research program continues, with the objective of further reducing the risks posed by the operation of aircraft in winter precipitation conditions.

Under contract to the TC Innovation Centre, with support from the FAA William J. Hughes Technical Center, TC Civil Aviation, and FAA Flight Standards – Air Carrier Operations, APS Aviation Inc. (APS) carried out research in the winter of 2020-21 in support of the aircraft ground icing research program. Each major project completed as part of the 2020-21 research is documented in a separate individual report. This report documents the wind tunnel Ice Pellet Allowance Time development project.

1.1 Background

In 2005-06, the inability for operators to release aircraft in ice pellet conditions led TC and the FAA to begin a research campaign to develop allowance times. Developing holdover times (HOTs) was not feasible due to the properties of the ice pellets; they remain embedded in the fluid and take long to dissolve compared to snow, which is immediately absorbed and dissolved. Research was initiated through live aircraft testing with the NRC Falcon 20 in Ottawa, Canada, and later progressed to a more controlled environment with the NRC 3 m x 6 m Icing Wind Tunnel (IWT), also in Ottawa.

The early testing in 2005-06 with the Falcon 20 primarily used visual observations to evaluate fluid flow-off. During the Falcon 20 work, the wing was anti-iced and exposed to contamination, and aborted takeoff runs allowed researchers onboard to observe and evaluate the fluid flow-off. Testing in 2006-07 began in the IWT, allowing aerodynamic data to be used for evaluating fluid flow-off performance. The IWT also allowed for a more controlled environment less susceptible to the elements.

The work continued each year, and the test methods and equipment improved, allowing for real-time data analysis, better repeatability, and overall greater confidence in the results. The work conducted by TC/FAA has been presented by APS to the SAE International (SAE) G-12 Aerodynamics Working Group (AWG) and the HOT Committee yearly since 2006. Additional presentations were also given at the AWG in May 2012 and May 2013 by National Aeronautics and Space Administration and the NRC that focused on the extensive calibration and characterization work performed with a generic thin high-performance airfoil. This work also helped increase confidence in how the data was used to help support the development of TC/FAA guidance material. A detailed account of the more recent work conducted is included in the TC report, TP 15232E*, Wind Tunnel Trials to Examine Anti-Icing Fluid Flow-Off Characteristics and to Support the Development of Ice Pellet Allowance Times, Winters 2009-10 to 2012-13* (1).

The Ice Pellet Allowance Time research has helped further develop and improve the IWT facility. As a result, a new medium is now available for aerodynamic testing of aircraft ground de/anti-icing fluids with or without contamination in a full-scale format. Several other ground deicing projects have been ongoing as a result of industry requests and are expected to continue. The IWT has evolved into a multidisciplinary facility; however, it continues to be the primary source for the development and further refinement of the ground deicing Ice Pellet Allowance Time guidance material.

For the winter of 2013-14, testing was once again focused on the development of Ice Pellet Allowance Times with intentions of conducting yearly or bi-yearly testing campaigns. During the winter of 2014-15, the Ice Pellet Allowance Time testing was suspended to allow for a European Aviation Safety Agency–led project looking at thickened fluid effects on unpowered elevators; TC and APS were also involved in this research. Ice Pellet Allowance Time testing resumed for the winter of 2015-16; however, funding was limited for the following winter and, therefore, no testing was conducted during the winter of 2016-17. Yearly testing resumed as of the winter of 2017-18, focusing on substantiating the allowance times for new-to-market fluids and expanding the existing allowance times. During the winter of 2020-21, the research continued, and this report contains the findings from these tests.

1.2 Program Objectives

A wind tunnel testing program was developed for the winter of 2020-21 with the primary objectives of conducting aerodynamic testing to accomplish the following:

- Substantiate the current Type IV fluid Ice Pellet Allowance Times with new fluids using the thin high-performance regional jet (RJ) airfoil and, weather permitting, at temperatures close to the fluid lowest operational use temperature (LOUT); and
- Extend the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol (EG) fluids using the thin high-performance RJ airfoil.

In addition, baseline dry wing tests were conducted daily as well as following system changes to validate the repeatability of the wind tunnel.

The statement of work for these tests is provided in Appendix A.

Table 1.1 demonstrates the groupings for the global set of tests conducted at the wind tunnel during the winter of 2020-21 on the RJ wing.

Table 1.1: Summary of 2020-21 RJ Wing Tests by Objective

Objective #	Objective	# of Runs
1	Baseline Tests (Dry Wing)	30
2	Ice Pellet Allowance Time Validation (New Fluids)	25
3	EG Fluids – Expansion of Allowance Times	62*
	Total	***117***

*13 of 62 tests also served as validation tests.

1.3 Previous Ice Pellet Allowance Time Tables

The Type IV allowance time tables have been available since the winter of 2007-08. Each year the Type IV testing has built upon the latest version of the allowance time table published in the TC and FAA HOT Guidelines.

In the case of Type III fluid, a preliminary table was developed during the winter of 2008-09; however, high rotation speed allowance time tables have only been available and published since the winter of 2014-15 following some more extensive testing. Future testing will build upon the latest version of the allowance time table published in the TC and FAA HOT Guidelines and look to expand the table to include low-speed rotations.

1.4 Report Format

The wind tunnel work has been conducted since the winter of 2006-07 and has been documented in yearly reports. TP 15232E (1) contains more thorough details regarding the testing methodologies as well as links to previous historical reports. The current report has been prepared in a more abbreviated format. The following list provides short descriptions of subsequent sections of this report:

a) Section 2 describes the methodology used in testing, as well as equipment and personnel requirements necessary to carry out testing;

b) Section 3 describes data collected during the full-scale testing conducted;

c) Section 4 describes the results from the validation testing for new-to-market Type IV fluids;

d) Section 5 describes the results from the research aimed at extending the allowance times for EG fluids;

e) Section 6 describes the general changes to the Ice Pellet Allowance Time Tables that resulted from the research conducted this year;

f) Section 7 provides a summary of the conclusions; and

g) Section 8 provides a summary of the recommendations.

2. METHODOLOGY

This section provides a brief description of the test methodology and equipment specific to the full-scale aerodynamic tests conducted at the NRC IWT.

NOTE: TP 15232E (1) contains more thorough details regarding the testing methodologies.

2.1 Test Schedule

Fifteen overnight days of testing were organized starting January 10, 2021. Setup and teardown times were kept to a minimum and completed during the first two hours on the first day of testing and during the last two hours on the last day of testing. Table 2.1 presents the calendar of wind tunnel allowance time tests performed with the RJ wing. At the beginning of each test day, a plan was developed that included the list of tests (taken from the global test plan) to be completed based on the weather conditions and testing priorities. This daily plan was discussed, approved, and modified (if necessary) by TC, the FAA, and APS.

Table 2.1: 2020-21 Calendar of Tests

Date (Start date of overnight)	**# of Tests Run**
January 10, 2021	6
January 11, 2021	8
January 12, 2021	9
January 13, 2021	4
January 14, 2021	8
January 17, 2021	7
January 18, 2021	9
January 19, 2021	8
January 20, 2021	9
January 21, 2021	8
January 24, 2021	7
January 25, 2021	9
January 26, 2021	8
January 27, 2021	8
January 28, 2021	9
Total	**117**

2.1.1 Wind Tunnel Procedure

To satisfy the fluid testing objective, simulated takeoff and climb-out tests were performed with the thin high-performance wing section. Different parameters including fluid thickness, wing temperature, and fluid freezing point were recorded at designated times during the tests. The thin high-performance wing section was constructed by the NRC in 2009 specifically to conduct these tests following extensive consultations with an airframe manufacturer to ensure a representative thin high-performance design.

The typical procedure for each fluid test is described below.

- The wing section was treated with anti-icing fluid, poured in a one-step operation (no Type I fluid was used during the tests).
- When applicable, contamination, in the form of simulated ice pellets, freezing rain, and/or snow, was applied to the wing section. Test parameters were measured at the beginning and end of the exposure to contamination.
- At the end of the contamination period, the tunnel was cleared of all equipment and scaffolding.
- The wind tunnel was subsequently operated through a simulated takeoff and climb-out test.
- The behaviour of the fluid during takeoff and climb-out was recorded with digital high-speed still cameras. In addition, windows overlooking the wing section allowed observers to document the fluid elimination performance in real-time.

The procedures for the wind tunnel trials are included in Appendix B. The procedures include details regarding the test objectives, test plan, procedure and methodology, and pertinent information and documentation.

2.1.2 Test Sequence

The length of each test (from start of setup to end of last measurement) varied largely due to the length of exposure to precipitation (if applicable). Time required for setup and teardown as well as preparing and configuring the wing section was relatively consistent from test to test. Figure 2.1 demonstrates a sample timeline for a typical wind tunnel trial. It should be noted that a precipitation exposure time of 30 minutes was used for illustration purposes; this time varied for each test depending on the objective.

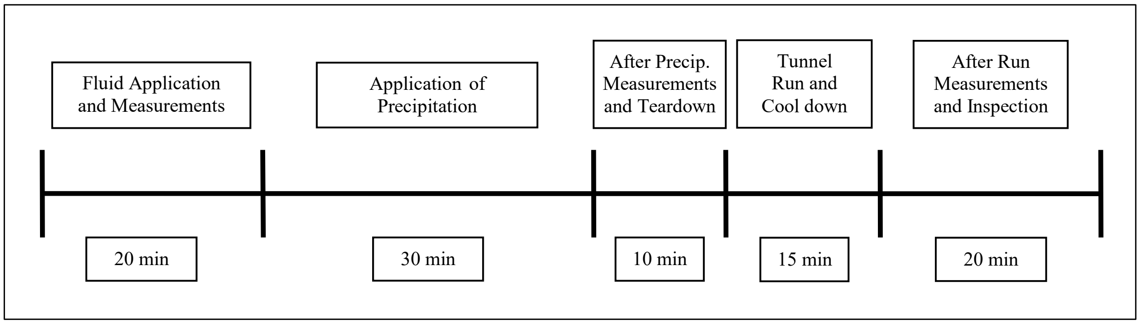


Figure 2.1: Typical Wind Tunnel Test Timeline

2.2 Methodology for Developing or Expanding New Allowance Times

Initial testing to first develop the allowance times is done with representative “grandfather” fluids (fluids with a long history of data). Testing is conducted at different temperatures and rates, and the allowance times are based on the limits where tests fail the acceptance criteria (based on visual ratings and aerodynamic performance). Much trial and error is needed to determine the limits of the allowance times (i.e., running tests with a grandfather fluid at 15, 20, and 25 minutes to determine that the allowance time should be limited to 20 minutes). Once the target allowance times are determined, they are validated using limited spot checks with multiple fluids. This methodology also applies to expanding allowance times for specific fluid types, like EG fluids.

2.3 Methodology for Validating New Fluids for Use with Allowance Times

Over the years, all new commercially available fluids have been tested. This is typically done when fluids become available commercially and are being mass produced. At a minimum, testing is conducted in a subset of conditions; the allowance times are generic, so this process is satisfactory and provides a “first alert” in the event that a fluid may be underperforming, in which case further action would be required.

2.4 Wind Tunnel and Airfoil Model Technical Overview

The following subsections describe the wind tunnel and major components.

2.4.1 Wind Tunnel Test Site

IWT tests are performed at the NRC Aerospace Facilities, Building M-46, at the NRC Montreal Road campus, located in Ottawa, Canada. Figure 2.2 provides a schematic of the NRC Montreal Road campus showing the location of the NRC IWT. Photo 2.1 shows an outside view of the wind tunnel trial facility. Photo 2.2 shows an inside view of the wind tunnel test section. The open-circuit layout, with a fan at entry, permits contaminants associated with the test articles (such as heat or de/anti-icing fluid) to discharge directly, without recirculating or contacting the fan. The test section is 3 m (10 ft.) wide by 6 m (20 ft.) high by 12 m (40 ft.) long, with a maximum wind speed of 78 knots when using the electrical turbine drive and with a maximum wind speed of just over 115 knots when using the gas turbine drive. The fan is normally driven electrically, but high-speed operation can be accommodated by a gas turbine drive system. Due to the requirements of both high-speed and low-speed operations during the testing, the gas turbine was selected to allow for greater flexibility; the gas turbine drive can perform both low- and high-speed operations, whereas the electric drive is limited to low-speed operations. Scaffolding was constructed to allow access to the wing section, which facilitated the application of fluids and the subsequent inspection and cleaning of the airfoil.

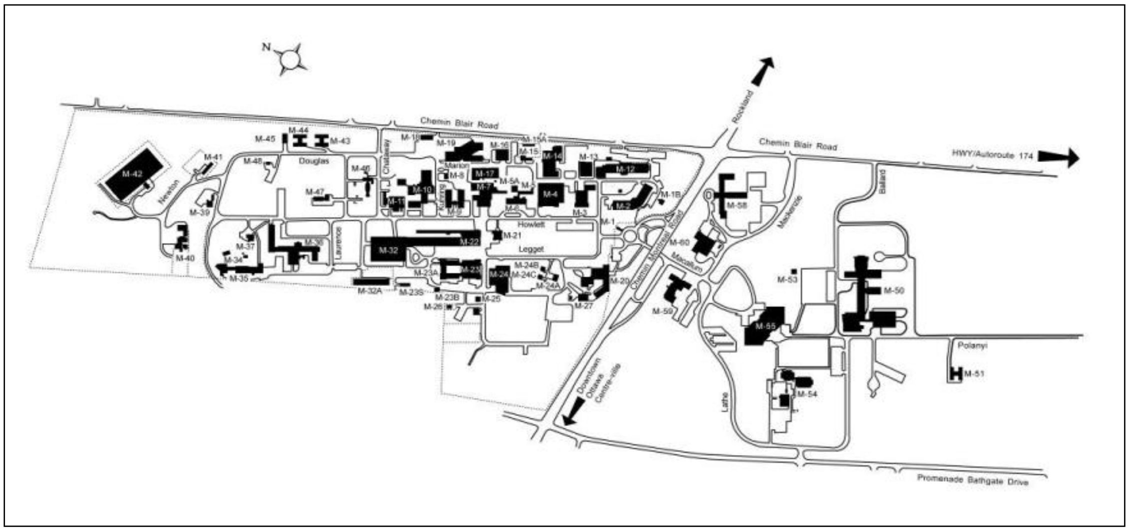


Figure 2.2: Schematic of NRC Montreal Road Campus

2.4.2 Generic Thin High-Performance "RJ" Type Commuter Airfoil

The wing section used for testing was a generic high-performance commuter airfoil, also referred to as a "thin high-performance" or "RJ" type. This wing section was constructed by the NRC in 2009 specifically to conduct these tests following extensive consultations with an airframe manufacturer to ensure a representative thin high-performance design. The original wing design was representative of an outboard section and did not include a flap; the flap was later added at the request of TC, the FAA, and APS. A computational fluid dynamics analysis of the modified wing section was conducted by the airframe manufacturer, and it was confirmed that the wing section provided a good representation of a flapped section of an operational thin high-performance wing. Photo 2.3 shows the wing section used for testing.

A cross sectional view of the thin high-performance wing section used for testing is represented in Figure 2.3; the dimensions indicated are in meters. Some of the pertinent dimensions of the wing section are as follows:

- Chord length not including flap: 1.4 m (4.6 ft.); and
- Width: 2.4 m (8 ft.).

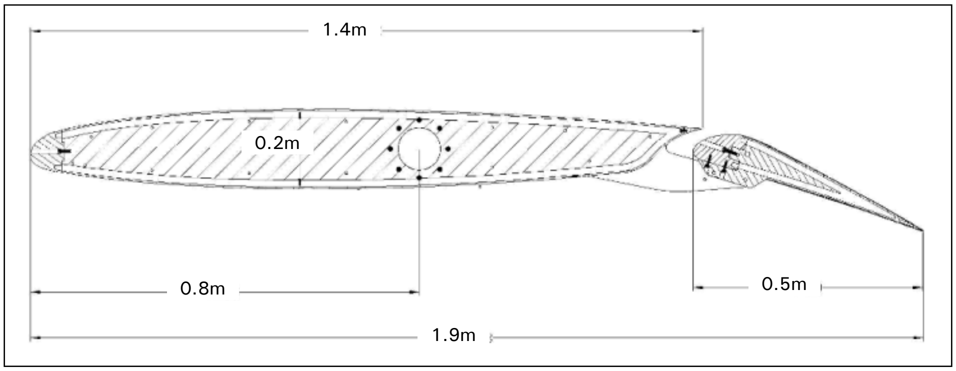


Figure 2.3: Generic "Thin High-Performance" Wing Section

An analysis of the wing section model was conducted by the airframe manufacturer to determine the typical rest position of this type of wing section. It was determined that, on a typical commuter aircraft, this section of wing would be pitched forward by 2° when sitting on the ground. As a result, the NRC ensured the rest position of the wing model was set to -2° for each test.

The wing section was fitted with a hinged flap. The flap position was fixed at 20° and was not intended to be changed during testing. The top surface of the flap wing section had a steeper angle; consequently, a flap setting of 20° created close to a 26° slope on the top surface of the flap (with the wing pitched forward by 2°). As testing progressed, the ability to change the flap setting from 0° to 20° was necessary; contrary to a nested flap, which is typically protected during precipitation, a hinged flap is always exposed, and results indicated earlier failures were due to the shallower angle of the hinged flap. Modifications were made by the NRC to allow the flap setting to alternate between 0° and 20° for the fluid application and contamination periods; however, all takeoff simulations were conducted with the flap set to 20°. No moveable devices were available on the wing section. Detailed coordinates for this airfoil are available upon request.

End plates were installed on the wing section to eliminate the “wall effects” from the wind tunnel walls and to provide a better aerodynamic flow-off above the test area. Figure 2.4 demonstrates the end plates installed on the thin high-performance wing section. (Note: The wing section is depicted without the top wing skin.)

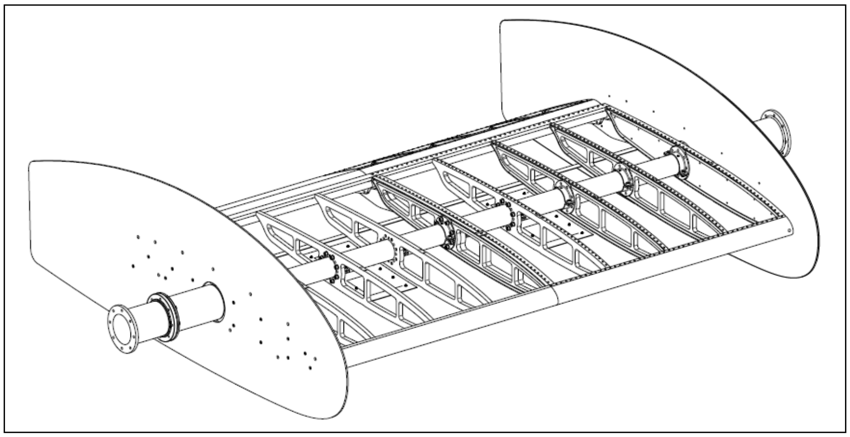


Figure 2.4: End Plates Installed on Thin High-Performance Wing Section

2.4.3 Test Area Grid

APS personnel used markers to draw a grid on the wing upper surface (excluding the flap). Each grid cell measured 5.1 cm x 5.1 cm (2 in. x 2 in.) with the cell axis positioned perpendicular and parallel to the leading edge (see Photo 2.4). The grid section was 2.4 m (8 ft.), which covered the entire wing section. The grid markings began aft of the leading edge stagnation point and continued along the length of the main chord; grid markings were not drawn on the flap section. The grid was used to facilitate observations of the fluid shearing off the wing and the movement of ice pellets during takeoff.

2.4.4 Wind Tunnel Measurement Capabilities

The wing section was supported on either side by 2-axis weigh scales capable of measuring drag and lift forces generated on the wing section. The wing section was attached to servo-systems capable of pitching the wing section to a static angle or generating dynamic movements. The servo-system was programmed to simulate pitch angles during takeoff and climb-out based on operational aircraft flight profiles.

The wing section was also equipped with eight resistance temperature detectors (RTDs); these were installed by NRC personnel to record the skin temperature on the leading edge (LE), mid-chord (MID), trailing edge (TE), and under-wing (UND). RTDs were placed in pairs along a chord 0.5 m (1.5 ft.) to the left and to the right of the wing centreline. The following are the locations of the RTDs for the RJ wing:

- RTD LE located approximately 25 cm from the leading edge (as measured along wing skin curvature);
- RTD MID located approximately 70 cm from the leading edge (as measured along wing skin curvature);
- RTD TE located approximately 30 cm from the trailing edge (as measured along wing skin curvature); and
- RTD UND located approximately 45 cm from the leading edge.

Figure 2.5 demonstrates the general location of the RTDs. These RTDs were primarily used to monitor the skin temperature in real-time through the NRC data display system and were recorded by APS personnel.

The wind tunnel was also equipped with sensors recording the following parameters:

1. Ambient temperature inside the tunnel;
2. Outside air temperature (OAT);
3. Air pressure;
4. Wind speed; and
5. Relative humidity.

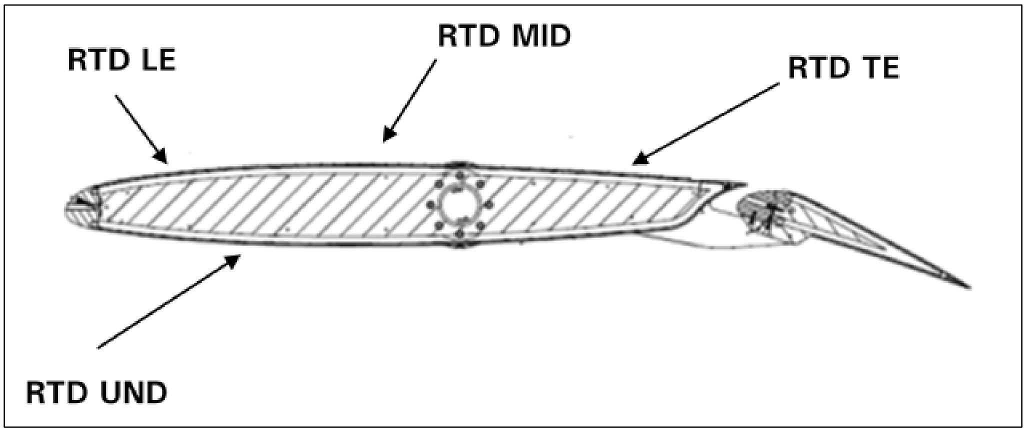


Figure 2.5: Location of RTDs Installed Inside Thin High-Performance Wing

2.5 Simulated Precipitation

The following types of precipitation have been simulated for aerodynamic research in the IWT:

1. Ice Pellets;
2. Snow;
3. Freezing Rain/Rain; and
4. Other conditions related to HOTs.

2.5.1 Ice Pellets

Simulated ice pellets were produced with diameters ranging from 1.4 mm to 4.0 mm to represent the most common ice pellet sizes observed during natural events. The ice pellets were manufactured inside a refrigerated truck (see Photo 2.5). Cubes of ice were crushed and passed through calibrated sieves (see Photo 2.6) to obtain the required ice pellet size range. Hand-held motorized dispensers (see Photo 2.7) were used to dispense the ice pellets. The ice pellets were applied to the leading and trailing edges of the wing at the same time.

2.5.2 Snow

Snow was produced using the same method for producing ice pellets. The snow used consisted of small ice crystals measuring less than 1.4 mm in diameter. Previous testing conducted by APS investigated the dissolving properties of the artificial snow versus natural snow. The artificial snow was selected as an appropriate substitute for natural snow.

The snow was manufactured inside a refrigerated truck. Cubes of ice were crushed and passed through calibrated sieves to obtain the required snow size range. Hand-held motorized dispensers were used to dispense the snow. The snow was applied to the leading and trailing edges of the wing at the same time.

2.5.3 Freezing Rain/Rain

The same sprayer head and scanner used for HOT testing at the NRC Climatic Engineering Facility was employed for testing. The sprayer system (see Photo 2.8) uses compressed air and distilled water to produce freezing rain. The temperature of the water is controlled and is kept just above freezing temperature to produce freezing rain. To produce rain, the temperature of the water is raised until the precipitation no longer freezes on the test surfaces.

2.5.4 Definition of Precipitation Rates

When simulating precipitation rates for full-scale and plate testing, the rate limits defined for standard HOT testing were referenced. Figure 2.6 demonstrates the HOT testing precipitation rate breakdown.

HOT testing protocol for ice pellets does not currently exist. As a result, ice pellet precipitation rate limits were based upon the freezing rain rate breakdown. The following precipitation rates were used for the full-scale and flat plate testing conducted during the winter of 2020-21:

1. Light Ice Pellets: 13-25 g/dm^2/h;
2. Moderate Ice Pellets: 25-75 g/dm^2/h;
3. Light Freezing Rain: 13-25 g/dm^2/h;
4. Freezing Drizzle (Heavy): 5-13 g/dm^2/h;
5. Light Rain: 13-25 g/dm^2/h;
6. Moderate Rain: 25-75 g/dm^2/h;
7. Light Snow: 4-10 g/dm^2/h; and
8. Moderate Snow: 10-25 g/dm^2/h.

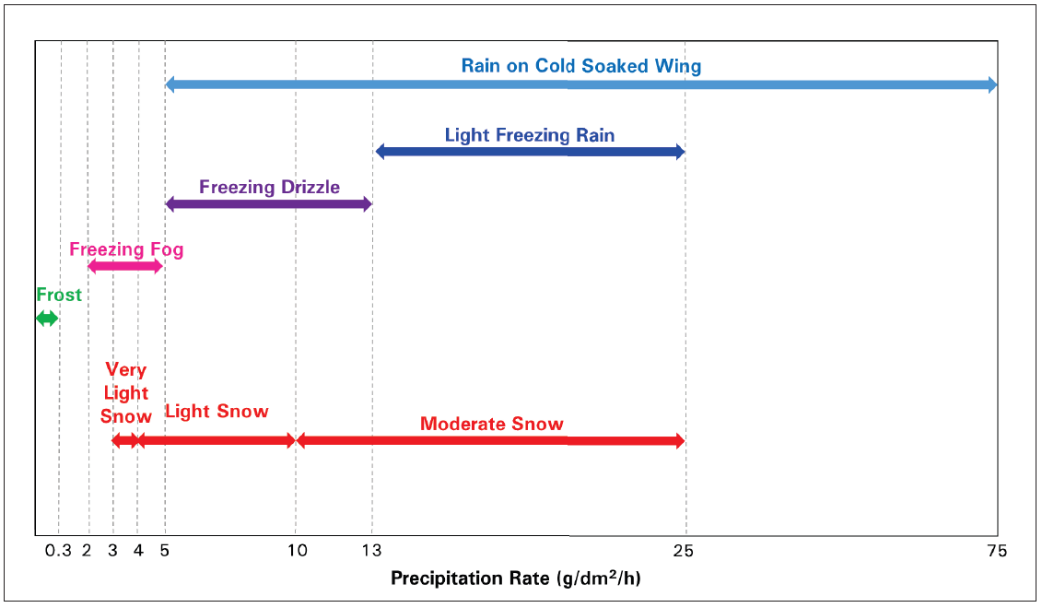


Figure 2.6: Precipitation Rate Breakdown

2.6 Test Equipment

A considerable amount of test equipment was used to perform these tests. Key items are described in the following subsections; a full list of equipment is provided in the test procedure, which is included in Appendix B.

2.6.1 Video and Photo Equipment

APS used the observation windows on the sides of the test section to install Canon® EOS XTi DSLR cameras and Profoto® Compact 600 flashes capable of second-by-second photography with an intervalometer. In addition, GoPro® and Osmo® cameras were used for wide-angle filming of fluid flow-off during the test runs.

During the winter of 2020-21, a closed-circuit television system (CCTV) was installed by APS and allowed remote viewing of the tests by stakeholders using iPad®-based software. The CCTV cameras were positioned to provide different angle views of the wing model. Due to interference issues from the flashes, the DSLR camera lighting was replaced with Godox SL150W II LED video lights, which improved video quality for the CCTV.

Photo 2.9 and Photo 2.10 demonstrate the camera setup used for the testing period.

2.6.2 Refractometer/Brixometer

Fluid freezing points were measured using a hand-held Misco 10431VP refractometer with a Brix scale (shown in Figure 2.7). The freezing points of the various fluid samples were determined using the conversion curve or table provided to APS by the fluid manufacturer.

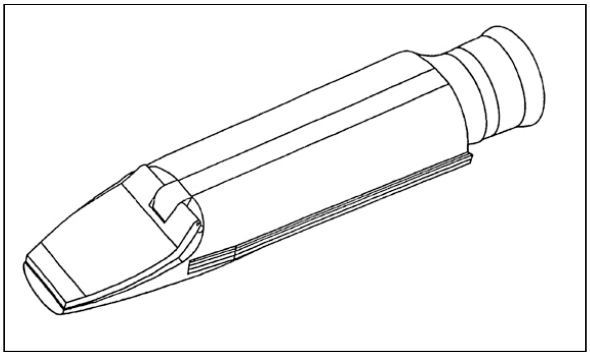


Figure 2.7: Hand-Held Refractometer/Brixometer

2.6.3 Wet Film Thickness Gauges

Wet film thickness gauges, shown in Figure 2.8, were used to measure fluid film thickness. These gauges were selected because they provide an adequate range of thicknesses (0.1 mm to 10.2 mm) for Type I/II/III/IV fluids. The rectangular gauge has a finer scale and was used in some cases when the fluid film was thinner (i.e., toward the end of a test). The observer recorded a thickness value (in mils), as read directly from the thickness gauge. The recorded value was the last wetted tooth of the thickness gauge; however, the true thickness lies between the last wetted tooth and the next un-wetted tooth. The measured thickness was corrected accordingly.

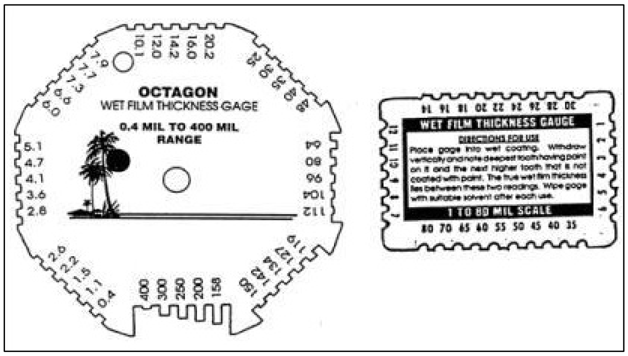


Figure 2.8: Wet Film Thickness Gauges

2.6.4 Hand-Held Immersion and Surface Temperature Probes

Hand-held immersion and surface temperature probes were used to provide instantaneous fluid temperature and wing skin temperature measurements during testing. These devices have an accuracy of ±0.4°C with a 2-3 second read time. Figure 2.9 shows a schematic of the probes.

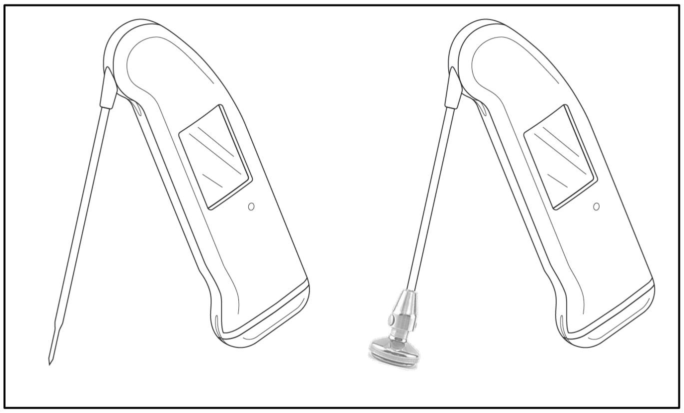


Figure 2.9: Hand-Held Immersion and Surface Temperature Probes

2.7 Personnel

During the fluid testing and exploratory research testing, three APS staff members were required to conduct the tests, and five additional persons from Ottawa were tasked to manufacture and dispense ice pellets as well as to help with general setup tasks. A professional photographer was retained to record digital images of the test setup and test runs. Representatives from TC and the FAA provided direction in testing and participated as observers. Photo 2.12 shows a portion of the research team (due to scheduling, not all participants were available for the photo).

2.8 Data Forms

Several different forms were used to facilitate the documentation of the various data collected in the wind tunnel trials. These forms include the following:

1. General Form;
2. Wing Temperature, Fluid Thickness and Fluid Brix Form;
3. Ice Pellet and Snow Dispensing Forms;
4. Sprayer Calibration Form;
5. Visual Evaluation Rating Form;
6. Condition of Wing and Plate Form;
7. Fluid Receipt Form; and
8. Log of Fluid Sample Bottles.

Copies of these forms are provided in the test procedure, which is included in Appendix B. Completed wing temperature, fluid thickness, and fluid Brix data forms have been included in Appendix C.

2.9 Data Collection

Fluid thickness, fluid Brix, and skin temperature measurements were collected by APS personnel. The measurements were collected before and after fluid application, after the application of contamination, and at the end of the test. The completed data forms have been scanned and included in Appendix C for referencing purposes.

High-speed digital photographs of each test were taken. In addition, videos were also recorded during a majority of the tests. Due to the large amount of data available, photos of the individual tests have not been included in this report, but the high-resolution photos have been provided to TC in electronic format and can be made available upon request.

2.10 De/Anti-Icing Fluids

For the winter of 2020-21, the new AllClear ClearWing EG and Cryotech Polar Guard Xtend fluids were received, and additional quantities of Dow EG106 were also received. Several other fluids remained in inventory from previous years' testing, and, of those, the EG-based fluids were used for allowance time expansion testing. The viscosity of all fluids in inventory was measured using the Brookfield Digital Viscometer Model DV-1+ to ensure the fluid was within the fluid manufacturer production specifications and comparable to previous samples received. The pertinent characteristics of these fluids are given in Table 2.2.

Table 2.2: Wind Tunnel Fluid Viscosity Information for 2020-21 Testing

					2017-18			2018-19			2019-20			2020-21		
Sample Name	**Dilution**	**Batch #**	**Year Rec’ d**	**Received Qty. (L)**	**Measured Viscosity (cP)**	**Falling Ball Temp. (°C)**	**Falling Ball Time (mm:ss)**	**Measured Viscosity (cP)**	**Falling Ball Temp. (°C)**	**Falling Ball Time (mm:ss)**	**Measured Viscosity (cP)**	**Falling Ball Temp. (°C)**	**Falling Ball Time (mm:ss)**	**Measured Viscosity (cP)**	**Falling Ball Temp. (°C)**	**Falling Ball Time (mm:ss)**
AllClear AeroClear MAX	100/0	TAB17-1023	2017-18	400	16,500	19.0	0:02				15,500			13,700		
CHEMCO ChemR EG IV	100/0	IV 35317-1	2017-18	400	46,000	19.6	0:13				48,400			49,700		
Clariant MaxFlight AVIA	100/0	41	2017-18	400	1,838	19.6	0:08	1,980	19.2	0:09	1,926			1,794		
Clariant MaxFlight SNEG	100/0	8	2017-18	400	18,700	19.6	0:39	19,100	19.5	0:41	19,700			19,900		
Clariant Safewing EG IV NORTH	100/0	01819	2018-19	400				1,028	19.2	0:05	956	19.5	0:06	1,042		
JSC RCP Nordix (Oksayd) Defrost EG 4	100/0	#1 (Lot #47)	2018-19	400				19,200	19.5	0:8	18,700			24,800		
JSC RCP Nordix (Oksayd) Defrost ECO 4	100/0	#4 (Lot #48)	2018-19	300				13,300	19.9	0:34	12,300			10,400		
DOW EG106	100/0	D268IB7001	2018-19	300							39,500			n/a		
Cryotech Polar Guard Advance	100/0	PGA181205PA	2018-19	300							14,820			14,760		
DOW EG106	100/0	D268KAG000	2020-21	300										42,980	20.0	1:21
Cryotech Polar Guard Xtend	100/0	PGX201104PA	2020-21	320										14,500	19.9	0:20
AllClear ClearWing EG	100/0	TAB20-CW1207	2020-21	400										41,620	n/a	n/a
CHEMCO ChemR EG IV	100/0	IV-201210-2	2020-21	120										50,200	20.1	0:16

Note: Viscosity was measured using manufacturer methods.

2.10.1 Viscometer

Historically, viscosity measurements have been carried out using a Brookfield viscometer (Model DV-1+, shown in Photo 2.13) fitted with a recirculating fluid bath and small sample adapter. In recent years, on-site measurements are also done with the Stony Brook PDVdi-120 Falling Ball Viscometer whenever possible (Photo 2.14) to obtain a quick verification of the fluid integrity. The falling ball tests are much faster and more convenient to perform compared to tests with the Brookfield viscometer. The falling ball, however, does not provide the absolute value of viscosity, but rather a time interval that is compared to historical samples to identify changes in viscosity.

2.10.2 Type II/III/IV Fluid Application Equipment

The Type II/III/IV fluids were stored outside the wind tunnel and were kept at ambient temperature. The fluids were poured rather than sprayed so that application would not change the fluid viscosity. This methodology was appropriate given the relatively small test area of the wing section and the goal of minimizing the amount of fluid flowing off the wing.

Type II/III/IV fluids are generally received in 20 L containers; however, some fluids are received in large 200 L barrels and larger 1000 L totes. The fluid is applied to the wing section by using smaller 2 L containers (see Photo 2.11). Approximately 16 L to 20 L of fluid were applied to the wing section for each test; less fluid was required for the less viscous Type III fluid. Due to the flat top surface of the thin high-performance wing, the thickened fluid did not easily settle and flow on the top surface. Therefore, the wing was tilted forward (by approximately 10°) for 1 minute following the end of fluid application to allow for the fluid to spread out evenly over the top surface of the wing.

2.10.3 Waste Fluid Collection

Using a relatively small test area and applying the fluids by pouring minimized the amount of fluid falling off the wing. The NRC also fitted the wind tunnel with appropriate drainage tubes to collect spent fluid during the takeoff test runs, which allowed APS personnel to squeegee residual fluid on the tunnel floor directly into the drains. At the end of the testing period, the services of a waste removal company were employed to safely dispose of the waste glycol fluid.

2.11 Analysis Methodology

The following provides a brief description of the analysis methodology. More details on the analysis methodology can be found in TP 15232E (1).

Each ice pellet test was analysed in detail using the following objectives:

1. Test parameters;
2. Visual ratings at the start of the test;
3. Visual ratings at rotation;
4. 8° lift loss; and
5. Overall test status.

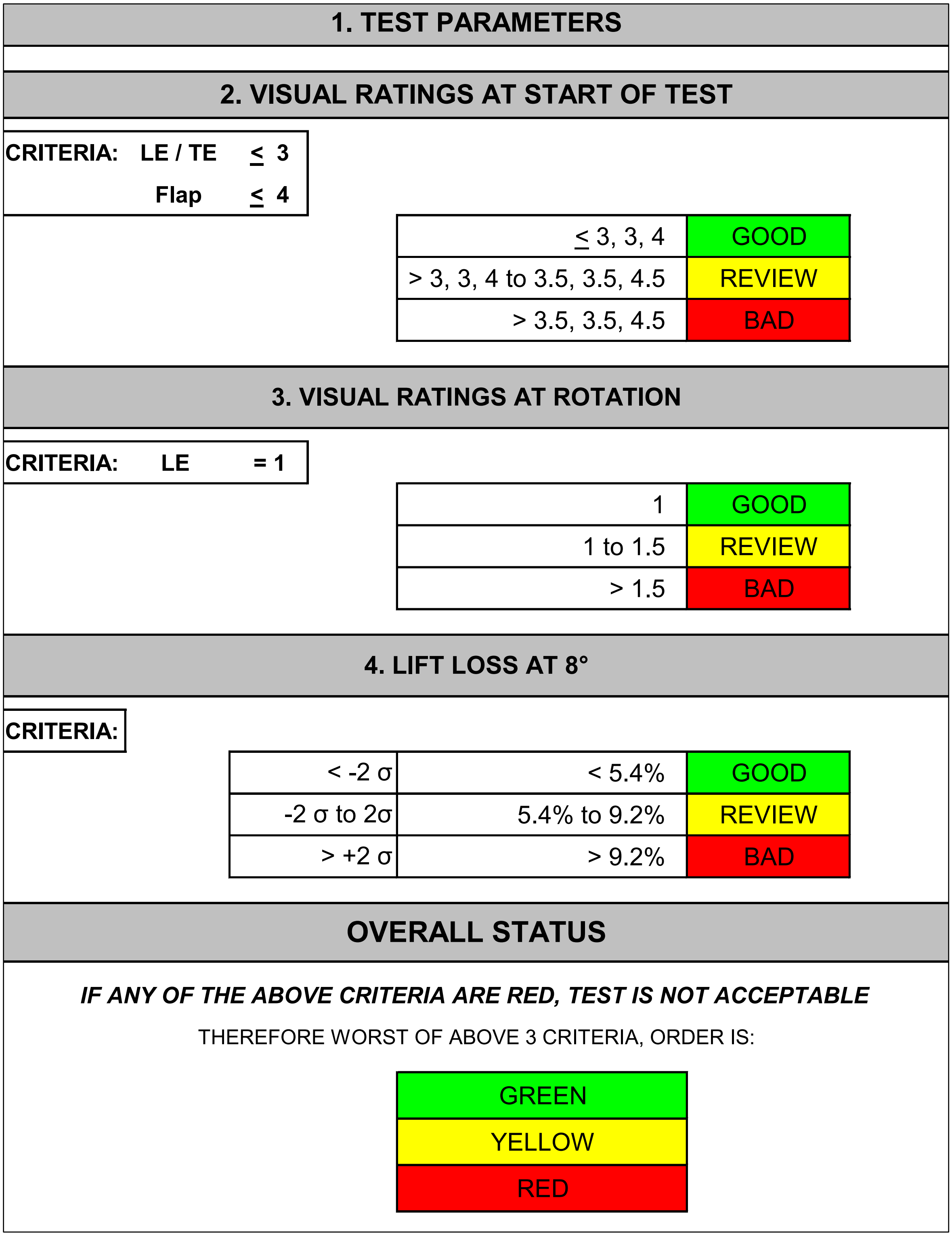
The evaluation grades for each criterion were “Good,” “Review,” or “Bad.” These grades were determined based on whether the criterion satisfied each test objective requirement. Figure 2.10 shows a summary of each test objective and criterion.

Several test parameters were evaluated, such as tunnel temperature before the start of the test, rate of precipitation, and exposure time of precipitation. These parameters were compared to the target parameters described in the test plan. The actual recorded ramp-up time was also evaluated and compared to the target ramp-up time to ensure representative flow-off results; this became less of an issue after 2011-12 with the use of the automated ramp-up system instead of the previous manual system.

2.11.1 Visual Ratings at the Start of the Test

During each of the tests conducted, visual contamination ratings were determined by three observers: one observer from the FAA and two observers from APS. The level of contamination present on the leading edge and trailing edge of the wing, as well as on the flap, was quantified using a scale of one-to-five with five being the worst case scenario; partial numbers were sometimes assigned when cases were marginally above or below a specific rating.

The visual contamination rating criteria at the start of the test on both the leading and trailing edges must be equal to 3 or less to pass. The flap must have a rating of 4 or less. For a review grade to be given, the leading and trailing edges must have a rating between 3 and 3.5, and the flap must have a rating between 4 and 4.5. Any rating greater than 3.5 on the leading and trailing edges is considered a fail, while anything greater than 4.5 on the flap is considered a fail.



1. TEST PARAMETERS

2. VISUAL RATINGS AT START OF TEST

CRITERIA: LE / TE ≤ 3
Flap ≤ 4

≤ 3, 3, 4	GOOD
> 3, 3, 4 to 3.5, 3.5, 4.5	REVIEW
> 3.5, 3.5, 4.5	BAD

3. VISUAL RATINGS AT ROTATION

CRITERIA: LE = 1

1	GOOD
1 to 1.5	REVIEW
> 1.5	BAD

4. LIFT LOSS AT 8°

CRITERIA:

< -2 σ	< 5.4%	GOOD
-2 σ to 2σ	5.4% to 9.2%	REVIEW
> +2 σ	> 9.2%	BAD

OVERALL STATUS

IF ANY OF THE ABOVE CRITERIA ARE RED, TEST IS NOT ACCEPTABLE

THEREFORE WORST OF ABOVE 3 CRITERIA, ORDER IS:

GREEN
YELLOW
RED

Figure 2.10: Ice Pellet Test Analysis Criteria

2.11.2 Visual Ratings at Rotation

The visual contamination rating criteria at the time of rotation on the leading edge must be equal to 1 or less to pass. For a review grade to be given, the leading edge must have a rating between 1 and 1.5. Any rating on the leading edge greater than 1.5 is considered a fail.

2.11.3 Eight-Degree Lift Loss

To pass, the 8° lift loss must be less than 5.4 percent. For a review grade to be given, the lift loss must be between 5.4 percent and 9.2 percent. Any lift loss greater than 9.2 percent is considered a fail.

2.11.4 Overall Test Status

After all objectives were analysed, the overall status was given a “Good,” “Review,” or “Bad” evaluation. This provided an overall summary for each test. The overall status was determined by the worst case scenario of any of the test objectives; if any of the criteria were given a “Bad” grade, the overall status would be “Bad” and the test considered a fail.

2.11.5 Dry Wing Calibration

To ensure the accuracy of the testing results, a dry wing calibration test was conducted at the start of each day. The dry wing test allowed the research team to ensure that the model aerodynamics did not change due to mechanical, communication, or analytical errors. Dry wing tests were also conducted following any mechanical modification to the airfoil (i.e., after applying the ice phobic wing skins). The dry wing results demonstrated that the changes in dry wing performance were within the range of experimental error and did not indicate any repeatability issues with the model.

Photo 2.1: Outside View of the NRC Wind Tunnel Facility

Photo 2.2: Inside View of the NRC Wind Tunnel Test Section

Photo 2.3: Thin High-Performance Wing Section Used for Testing

Photo 2.4: Grid Markings on Thin High-Performance Wing Section

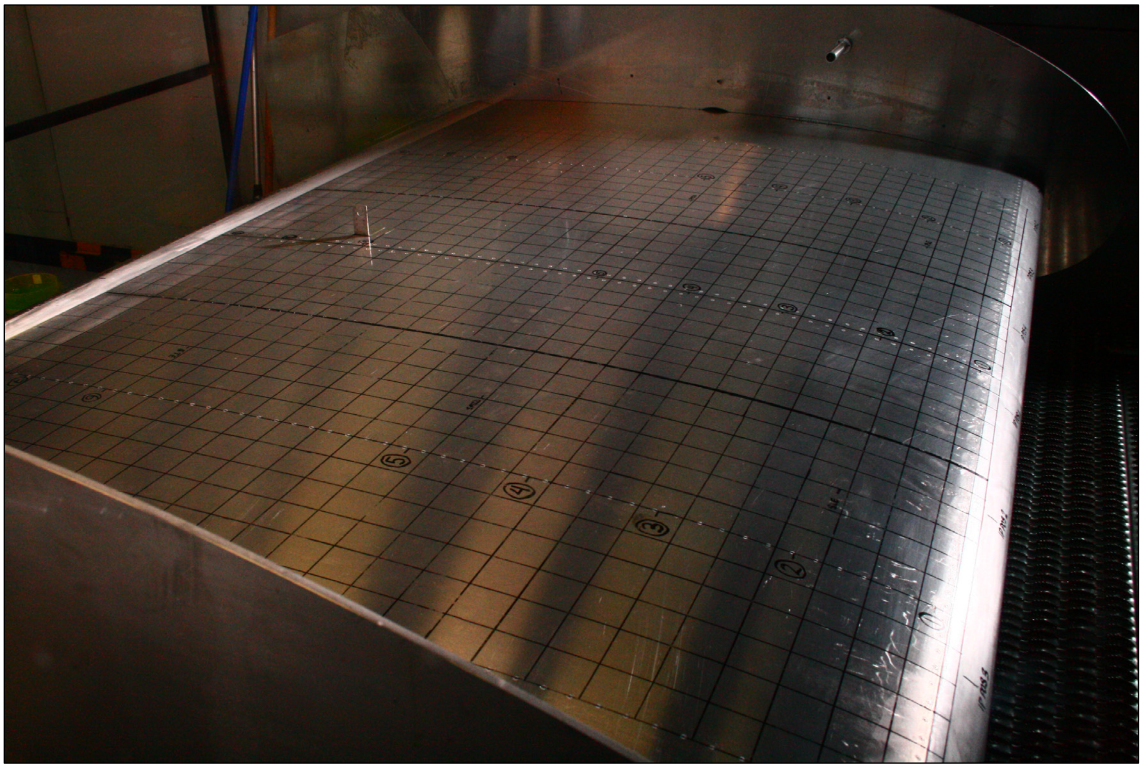


Photo 2.5: Refrigerated Truck Used for Manufacturing Ice Pellets

Photo 2.6: Calibrated Sieves Used to Obtain Desired Size Distribution

Photo 2.7: Ice Pellet Dispensers Operated by APS Personnel

Photo 2.8: Ceiling-Mounted Freezing Rain Sprayer

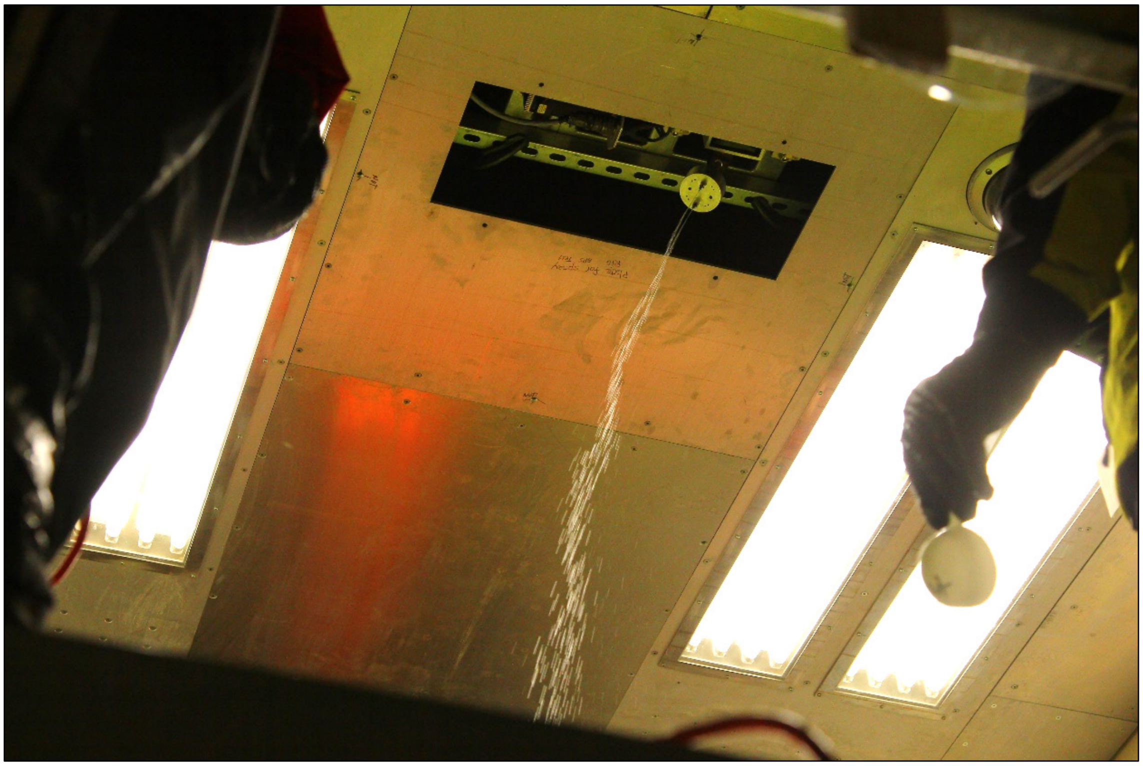


Photo 2.9: Wind Tunnel Setup for Flashes

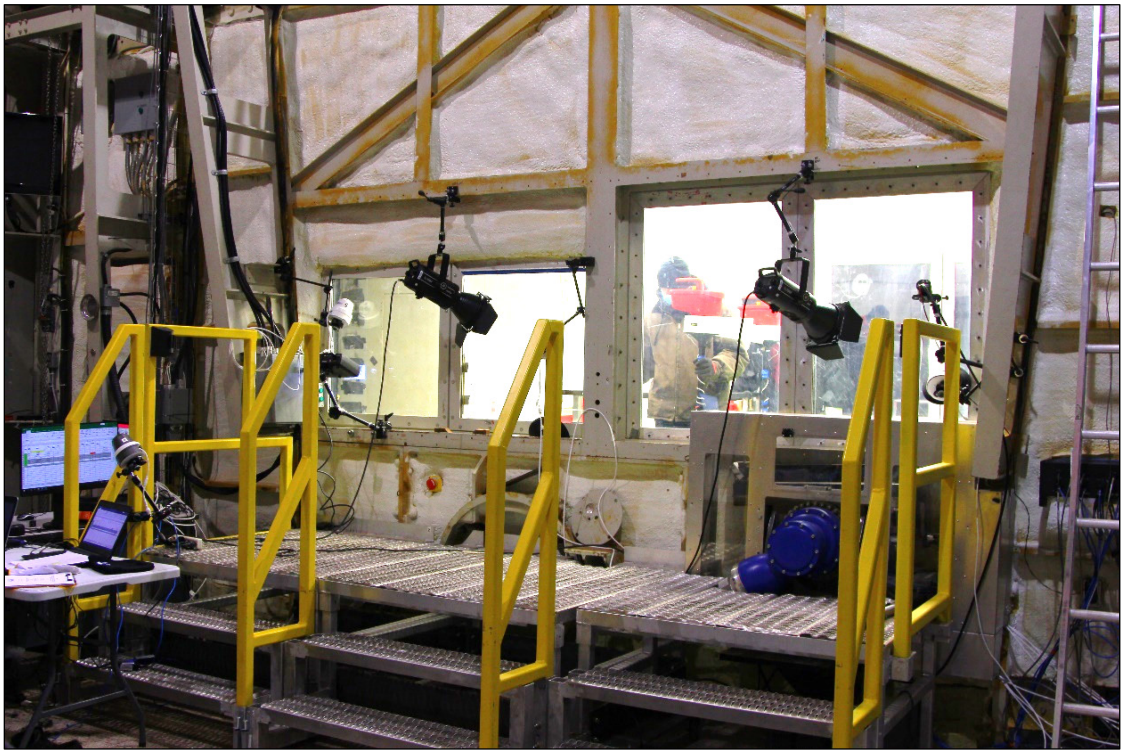


Photo 2.10: Wind Tunnel Setup for Digital Cameras

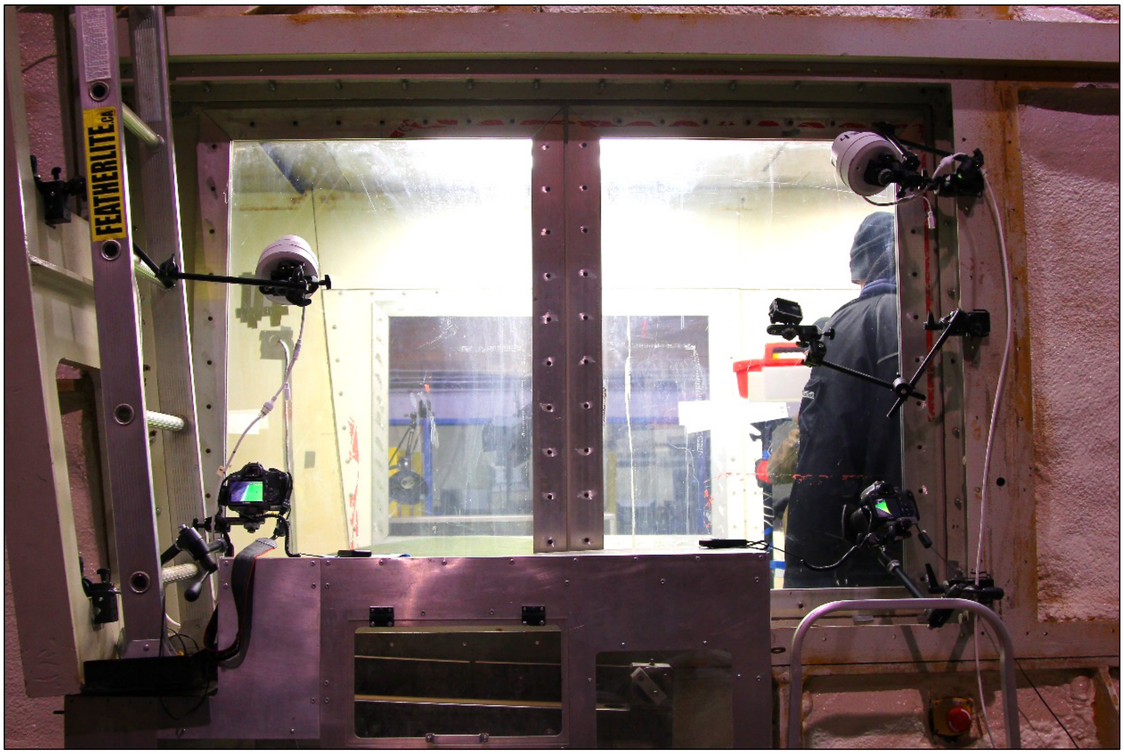


Photo 2.11: Fluid Pour Containers

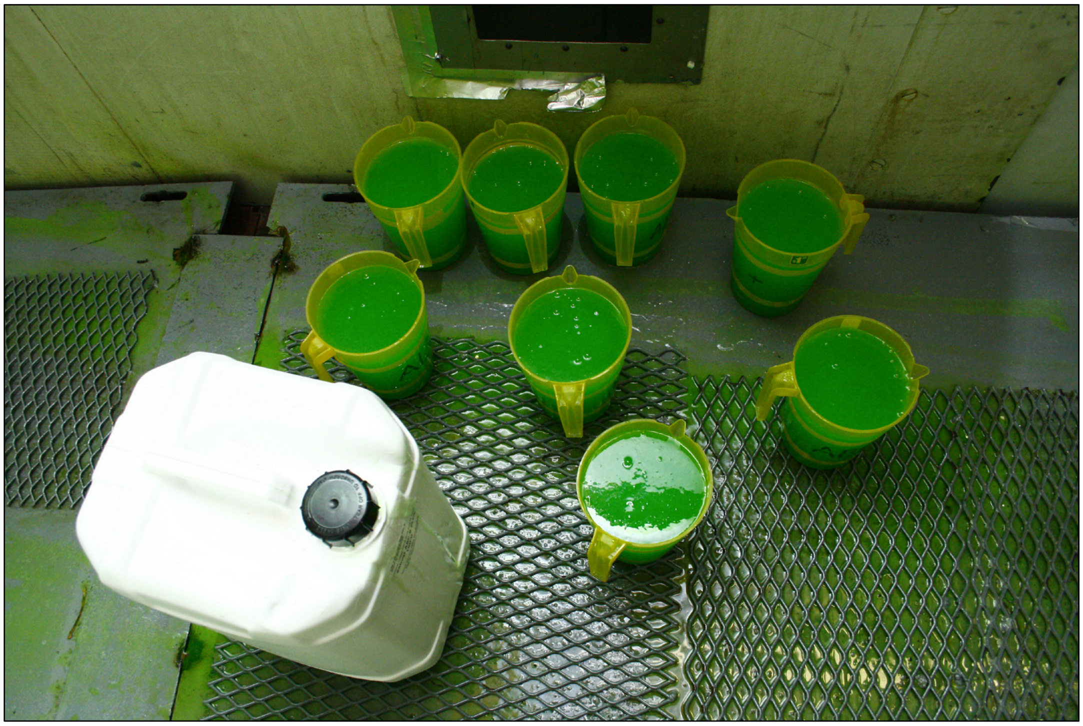


Photo 2.12: 2020-21 Research Team

Photo 2.13: Brookfield Digital Viscometer Model DV-1+

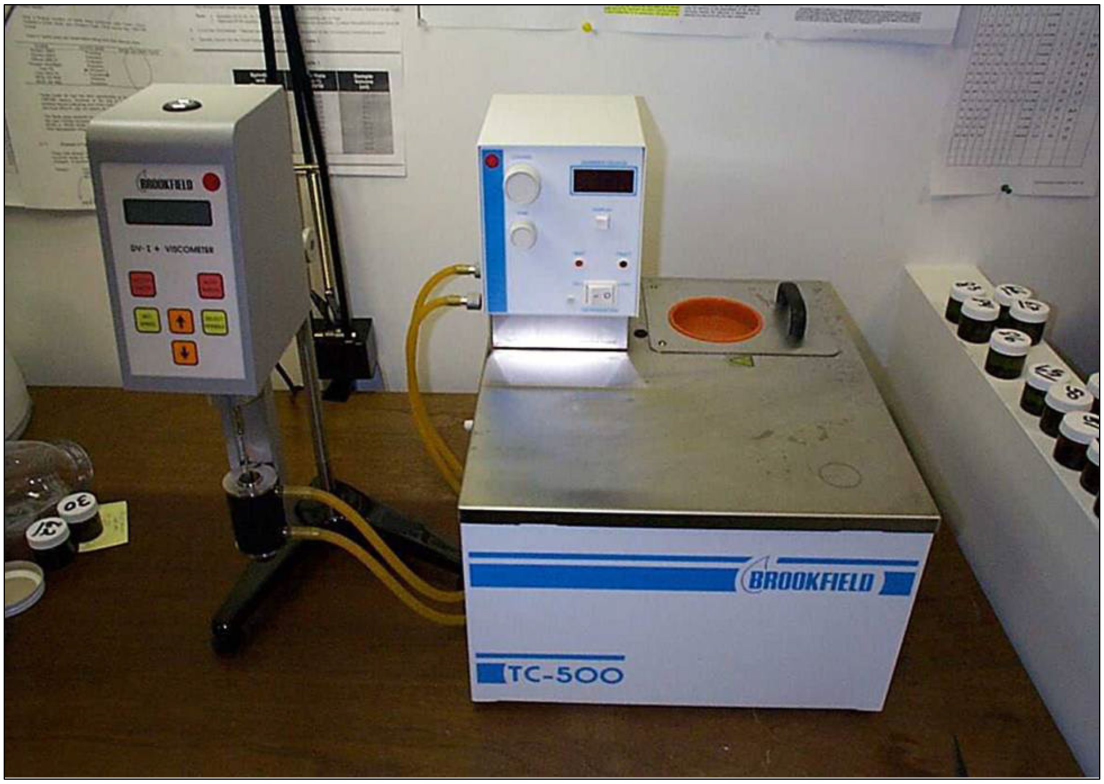


Photo 2.14: Stony Brook PDVdi-120 Falling Ball Viscometer

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3. FULL-SCALE DATA COLLECTED

3.1 Test Log

A calendar of the tests conducted during the winter of 2020-21 can be found in Table 2.1. A detailed log of the tests conducted in the NRC IWT during the winter of 2020-21 is included in Appendix D. The log provides relevant information for each of the tests, as well as final values used for the data analysis. Each row contains data specific to one test. The following is a brief description of the column headings for the logs included in Appendix D.

Test #:	Exclusive number identifying each test run.
Date:	Date when the test was conducted.
Test Plan #:	The unique number identifying the test in the overall plan specific to the test year.
Objective:	Main objective of the test.
Test Condition:	Description of the simulated conditions for the test.
Fluid Name:	Aircraft anti-icing fluid used during the test.
Rotation Angle:	Maximum angle of rotation obtained during simulated takeoff run; began testing with a max 8° rotation angle and increased to 20° as testing progressed.
Speed (kts):	Maximum speed obtained during simulated takeoff run, recorded in knots.
Flap Angle (0°, 20°):	Positioning of the flap during the precipitation period; either 0° (retracted) or 20° (extended). *Note: Flap was always extended at 20° during the takeoff run.*
Corrected for 3D Effects % Lift Loss at 8° C_L vs. Dry C_L:	Percent lift loss calculated based on the comparison of the 8° lift coefficient during the test run versus the 8° dry wing average lift coefficient.

Tunnel Temp. Before Test (°C):	Static tunnel air temperature recorded just before the start of the simulated takeoff test, measured in degrees Celsius. *Note: This parameter was used as the actual test temperature for analysis.*
OAT Before Test (°C):	OAT recorded just before the start of the simulated takeoff test, measured in degrees Celsius. *Note: This is not an important parameter as "Tunnel Temp. Before Test" was used as the actual test temperature for analysis.*
Avg. Wing Temp. Before Fluid Appl. (°C):	The average of the wing temperatures just before the fluid was applied.
Avg. Wing Temp. Before Test (°C):	The average of the wing temperatures just before the test.
XX Rate (g/dm^2/h):	Simulated freezing precipitation rate (or combination of different precipitation rates) for Ice Pellets (IP), Snow (SN), Freezing Rain (ZR), and Rain (R).
Exposure Time (min.):	Simulated precipitation period, recorded in minutes.

The visual contamination ratings are described below. Visual contamination ratings were typically reported as the average of the three observer ratings and rounded to the nearest decimal. The visual contamination ratings system is further described in Subsection 2.11.

Visual Contamination Rating Before Takeoff (LE, TE, Flap):	Visual contamination rating determined before the start of the simulated takeoff: 1 - Contamination not very visible, fluid still clean; 2 - Contamination is visible, but lots of fluid still present; 3 - Contamination visible, spots of bridging contamination; 4 - Contamination visible, lots of dry bridging present; and 5 - Contamination visible, adherence of contamination.

Visual Contamination Rating at Rotation (LE, TE, Flap):	Visual contamination rating determined at the time of rotation: 1 - Contamination not very visible, fluid still clean; 2 - Contamination is visible, but lots of fluid still present; 3 - Contamination visible, spots of bridging contamination; 4 - Contamination visible, lots of dry bridging present; and 5 - Contamination visible, adherence of contamination.
Visual Contamination Rating After Takeoff (LE, TE, Flap):	Visual contamination rating determined at the end of the test: 1 - Contamination not very visible, fluid still clean; 2 - Contamination is visible, but lots of fluid still present; 3 - Contamination visible, spots of bridging contamination; 4 - Contamination visible, lots of dry bridging present; and 5 - Contamination visible, adherence of contamination.

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4. VALIDATION TESTING FOR NEW-TO-MARKET TYPE IV FLUIDS

The Type IV fluid Ice Pellet Allowance Times are developed based on data collected using commercially available Type IV fluids. The Type IV fluid Ice Pellet Allowance Times are generic and, therefore, conservative. As new fluids are developed and become commercially available, it is important to evaluate these fluids against the current allowance times to ensure the validity of the generic guidance. Systematic "spot-checking" is used to identify any potential issues. In addition, testing is recommended with all available fluids to obtain data close to the fluid LOUT; this further allows the aerodynamic effects of ice pellet contamination at colder temperatures to be determined. To meet these requirements, testing was conducted during the winter of 2020-21 with the following Type IV EG and propylene glycol (PG) fluids:

1. AllClear ClearWing EG; and
2. Cryotech Polar Guard Xtend.

The following subsections will provide an overview of the analysis format and a summary of the results obtained for each of the fluids tested.

4.1 Allowance Time Table Analysis Format

For each fluid tested, a table has been included that provides a summary of the tests conducted. The results from the individual tests are included in a mock-up allowance time table indicating the current Ice Pellet Allowance Times as well as the individual test information in the respective cell. The individual test information has been included in the following format:

- FFAA(BB)CC[DD]GGE
  - FF is the fluid name designation based on the following:
    - AllClear ClearWing – CW; and
    - Cryotech Polar Guard Xtend – XT.
  - AA is the static tunnel ambient temperature recorded just before the start of the simulated takeoff test, measured in degrees Celsius and rounded to the closest degree.
  - BB is the percent Lift Loss calculated based on the comparison of the 8° lift coefficient during the test run versus the dry wing average lift coefficient.
  - CC is the exposure time of the test in minutes.

- DD is the test number for referencing the data in the test logs.
- GG is the last two digits of the year of testing (i.e., 2020-21 is "21").
- E is the status of the testing, either "G" for good, "R" for review, or "B" for bad, as per the guidelines. The highlighting is in a corresponding green, yellow, or red colour. An additional colour, pink was added for tests that failed due to the visual rating, which identified adherence on the flap at the start of the test with the flap configured down (in the takeoff position).
- The test information is included in the cell for which the temperature band best corresponds to the temperature recorded during the test.

The purpose of these tables is to provide a quick reference of the test results vis-a-vis the current allowance times to better understand in which cells the times have been validated or where potential issues may be identified.

4.2 ClearWing EG Testing Results

A total of 18 allowance time tests were conducted with AllClear ClearWing EG fluid. As this was an EG fluid and it was expected that the fluid would perform well in specific conditions, some tests were conducted for longer than published allowance times so the test could serve a dual purpose: validating the existing allowance times and potentially supporting the expansion of the table for EG fluids.

Table 4.1 provides a summary of the tests conducted that served strictly as validation tests (i.e., the exposure time of the test was equivalent to the current allowance times). All tests conducted were acceptable from a visual and aerodynamic perspective with the exception of Test #40 run in Light Ice Pellets Mixed with Freezing Rain and Test #23 run in Light Ice Pellets Mixed with Rain. In both cases, the tests failed due to the visual rating, which identified adherence on the flap at the start of the test run after the EG fluid and contamination had been applied with the flap extended (in the takeoff position). Test #40 was re-run as Test #41 with EG fluid and contamination applied with the flap retracted for the contamination period, and the results improved as expected (aligned with historical observations). Test #23 was not re-run as it is known that the visual would improve with the flap retracted during the contamination period and because the lift loss was low.

Table 4.2 provides a summary of the tests conducted that served as expansion tests (i.e., the exposure time of the test exceeded the current allowance time). Tests #42 and #98 had "Review" status due to visual ratings on the leading edge at the start of rotation and, in the case of Test #98, the visuals on the leading edge at the time of rotation as well. The low lift losses recorded indicated that these tests could be considered acceptable. Tests #13, #14, #73, #80, #88, and #92 all had "Bad" ratings. In all but Test #13, the tests failed due to the visual rating, which identified adherence on the flap at the start of the test with the flap extended (in the takeoff position) during fluid application and exposure to contamination; the tests were not re-run as it is known that the visual would improve with the flap retracted during contamination and because the lift loss was acceptable. In the case of Test #13, the temperature was near freezing and caused more severe adherence, which may not have been representative test. The re-run of the test as Test #14 provided more representative results.

Table 4.3 provides a consolidated summary of all the tests conducted. In general, the fluid met and exceeded the current allowance times. In the cases where the results had “Bad” status, the flap deployed position during fluid application and exposure to contamination was the contributing factor, and previous research has shown that a significant improvement is expected if the test is conducted with the flap in the retracted position. In the cases where the results had “Review” status, the visual contamination was borderline; however, the low lift losses recorded indicated that these tests could be considered acceptable.

Based on these results, the allowance times were validated for AllClear ClearWing EG, and the results indicate a good potential to increase the allowance times for EG fluids.

Table 4.1: ClearWing EG Allowance Time Validation Tests

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	50 minutes CW0(1.4)50[10]21G	30 minutes	30 minutes	30 minutes
Light Ice Pellets Mixed with Snow	40 minutes CW-5(2.8)40[39]21G	15 minutes	15 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Freezing Rain	25 minutes CW-6(7.3)25[40]21B CW-6(1.6)25[41]21G*-	10 minutes		
Light Ice Pellets Mixed with Rain	25 minutes CW0(3.1)25[23]21B			
Moderate Ice Pellets (or Small Hail)	25 minutes CW-5(2.0)25[38]21G	10 minutes	10 minutes	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

Table 4.2: ClearWing EG Allowance Time Expansion Tests

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	50 minutes CW-4(2.6)70[99]21G	30 minutes CW-8(2.7)50[49]21G	30 minutes	30 minutes
Light Ice Pellets Mixed with Snow	40 minutes CW-3(3.3)50[98]21R	15 minutes CW-9(4.9)30[63]21G	15 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes CW-2(7.8)40[92]21B	10 minutes CW-9(6.7)30[80]21B		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes CW-2(6.5)40[73]21B	10 minutes		
Light Ice Pellets Mixed with Rain	25 minutes			
Moderate Ice Pellets (or Small Hail)	25 minutes CW-8(2.2)35[42]21R	10 minutes	10 minutes	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes CW-3(7.1)20[88]21B	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes CW0(13.0)20[13]21B* CW-1(7.1)15[14]21B* CW2(1.0)20[32]21G			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

Table 4.3: All ClearWing EG Allowance Time Tests

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	50 minutes CW0(1.4)50[10]21G CW-4(2.6)70[99]21G	30 minutes CW-8(2.7)50[49]21G	30 minutes	30 minutes
Light Ice Pellets Mixed with Snow	40 minutes CW-5(2.8)40[39]21G CW-3(3.3)50[98]21R	15 minutes CW-9(4.9)30[63]21G	15 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes CW-2(7.8)40[92]21B	10 minutes CW-9(6.7)30[80]21B		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes CW-6(7.3)25[40]21B CW-6(1.6)25[41]21G*- CW-2(6.5)40[73]21B	10 minutes		
Light Ice Pellets Mixed with Rain	25 minutes CW0(3.1)25[23]21B			
Moderate Ice Pellets (or Small Hail)	25 minutes CW-5(2.0)25[38]21G CW-8(2.2)35[42]21R	10 minutes	10 minutes	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes CW-3(7.1)20[88]21B	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes CW0(13.0)20[13]21B* CW-1(7.1)15[14]21B* CW2(1.0)20[32]21G			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.
- Flap up test.

4.3 Polar Guard Xtend Testing Results

A total of 14 allowance time tests were conducted with Cryotech Polar Guard Xtend. Table 4.4 provides a summary of the tests conducted. Of the tests, three were acceptable from a visual and aerodynamic perspective; however, eight tests (#5, #6, #45, #46, #54, #89, #111, and #112) had “Review” status, and three tests (#68, #113, and #115) had “Bad” status. Upon further investigation of the “Review” tests, Tests #45, #46, #54, #89, #111, and #112 demonstrated lift losses that were above the 5.4 percent lower limit but still well below the 9.2 percent upper limit, and they were acceptable according to the visual rating. It is common for fluids to demonstrate higher lift losses at colder temperatures; therefore, these results were not of concern. Tests #5 and #6 had visual contamination on the leading edge at the time of rotation, which were slightly higher the acceptable limit; however, the low lift losses recorded indicated that these tests could be considered acceptable.

Upon further investigation of the "Bad" tests, Tests #113 and #115 failed both due to the lift losses recorded of 9.8, which were above the 9.2 precent upper limit. These tests were conducted at 115 knots and were at the bottom end of the temperature band, making them the most restrictive test conditions. A third test (#68) failed due to the lift loss recorded of 9.4, which was above the 9.2 precent upper limit, as well as the visual rating on the leading edge at rotation, which was higher than the acceptable limit. In all three tests, the results were marginally outside of the acceptable limits. It should be noted that the -16ºC fluid only test recorded a lift loss of 7.0 percent.

These test conditions have been problematic for other PG fluids tested in the past; this is why the allowance times were changed to 115 knots at below -10ºC and why allowance times do not apply for PG fluids below -16ºC. The Polar Guard Xtend data were compared to historical PG fluid data to understand how the results compare in the three cells of interest as well as in fluid only tests. The results are presented in Table 4.5, Table 4.6, Table 4.7, and Table 4.8, and graphically in Figure 4.1, Figure 4.2, Figure 4.3, and Figure 4.4. The results indicated that the fluid performance was consistently in the higher range of lift loss as compared to other PG fluids tested in similar conditions. In addition, the fluid viscosity information summarized in Figure 4.5 indicates that the fluid viscosity was in the middle of the manufacturers stated production range and thus was appropriate for testing purposes.

Based on the results obtained, the validation testing for Cryotech Polar Guard Xtend is considered incomplete. The three problematic data points were at or outside the temperature limits, which could nullify those data points. More testing is recommended before any changes to the guidelines are considered.

Table 4.4: All Polar Guard Xtend Allowance Time Tests

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	50 minutes XT-2(4.0)50[5]21R	30 minutes XT-9(7.5)30[46]21R	30 minutes XT-16(9.8)30[113]21B	30 minutes
Light Ice Pellets Mixed with Snow	40 minutes XT-4(7.1)40[6]21R	15 minutes XT-10(9.4)15[68]21B	15 minutes XT-15(7.7)15[111]21R XT-15(8.4)15[112]21R	
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes XT0(3.5)25[11]21*	10 minutes XT-8(7.1)10[45]21R		
Light Ice Pellets Mixed with Rain	25 minutes			
Moderate Ice Pellets (or Small Hail)	25 minutes XT1 (3.7)15[9]21G	10 minutes XT-5(7.5)10[54]21R	10 minutes XT-17(9.8)10[115]21B	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes XT-3(6.6)10[89]21R	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes XT0(2.8)10[12]21*			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

Table 4.5: Historical PG Data for IP-/SN- Below -5°C to -10°C

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)
Winter 2017-18	**11**	IP- / SN-	Other PG Fluid	8	100	20	-	4.96%	-5.5	-10.1
Winter 2009-10	**94**	IP- / SN-	Other PG Fluid	8	100	20	-	4.60%	-6.3	-12.9
Winter 2015-16	**22**	IP- / SN-	Other PG Fluid	8	100	20	-	6.95%	-6.5	-9.6
Winter 2018-19	**27**	IP- / SN-	Other PG Fluid	8	100	20	Snow sucked in from outside and stuck to LE	9.91%	-8.35	-13.4
Winter 2018-19	**26**	IP- / SN-	Other PG Fluid	8	100	20	-	7.75%	-8.51	-13.9
Winter 2020-21	**47**	IP- / SN-	Other PG Fluid	8	100	20	-	8.10%	-8.68	-9
Winter 2010-11	***56***	*IP- / SN-*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*6.78%*	*-9.6*	*-14.6*
Winter 2020-21	**68**	IP- / SN-	Polar Guard Xtend	8	100	20	-	9.40%	-9.68	-13
Winter 2010-11	***58***	*IP- / SN-*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*7.63%*	*-11.2*	*-13.7*

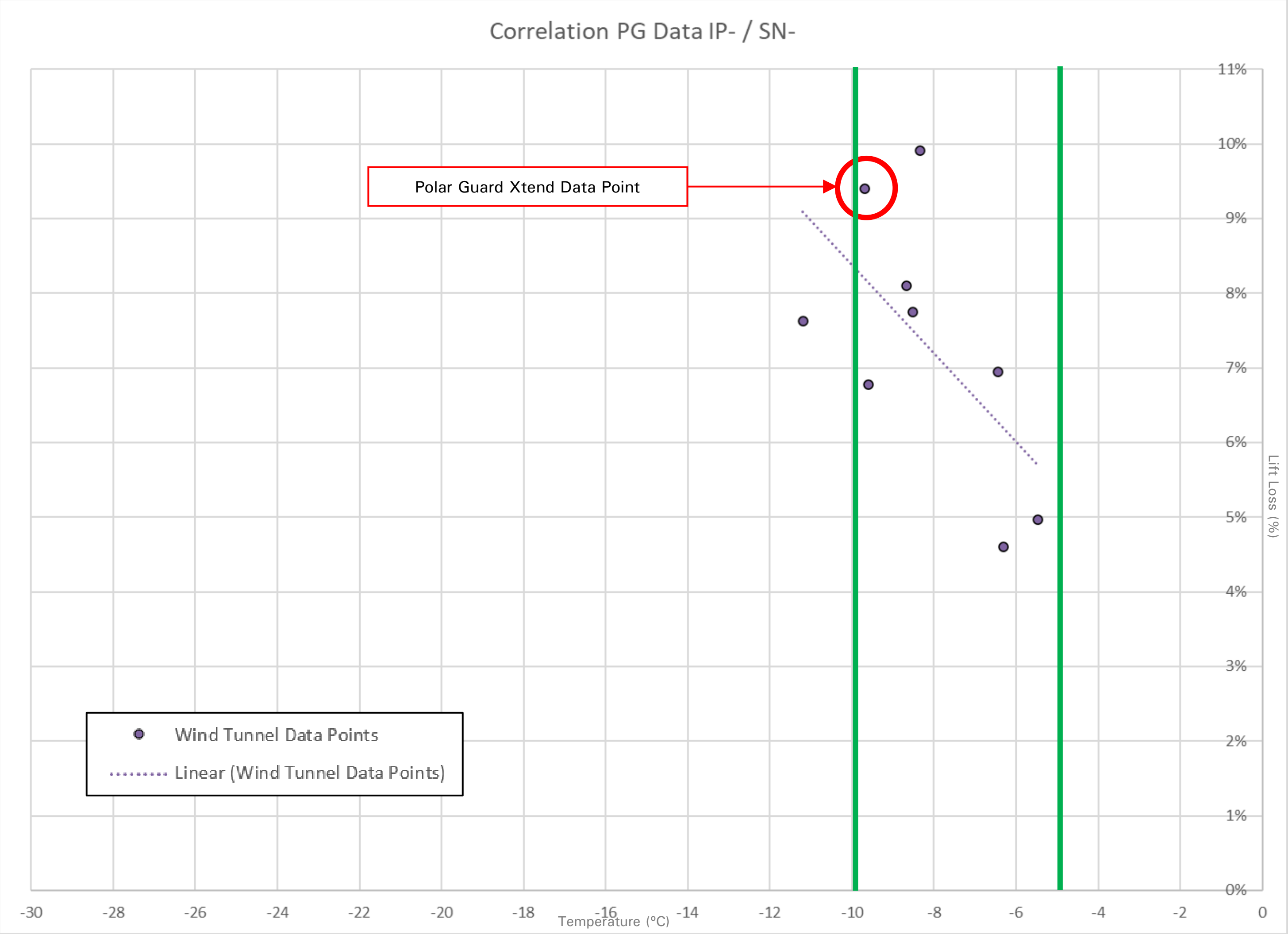


Figure 4.1: Correlation of PG Data for IP-/SN- Below -5°C to -10°C

Table 4.6: Historical PG Data for IP- Below -10°C to -16°C

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)
Winter 2010-11	**8**	IP-	Other PG Fluid	8	115	20		**2.88%**	-8.5	-11.4
Winter 2012-13	**91**	IP-	Polar Guard Advance	8	115	20	Didn't reach 115 kts	6.58%	-11.9	-19
Winter 2012-13	**97**	IP-	Other PG Fluid	8	115	20	Didn't reach 115 kts	7.58%	-14	-19.5
Winter 2017-18	**20**	IP-	Other PG Fluid	8	115	20	115 kts for PG	6.54%	-15.8	-16.8
Winter 2020-21	**113**	IP-	Polar Guard Xtend	8	115	20	115 kts for PG	9.75%	-16.19	-16.3
Winter 2012-13	**159**	IP-	Other PG Fluid	8	115	20		6.53%	-16.2	-21.5
Winter 2010-11	***20***	*IP-*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED*	*8.27%*	*-17.5*	*-20*
Winter 2018-19	**13**	IP-	Other PG Fluid	8	115	20	115 kts for PG	7.07%	-19.8	-19.5
Winter 2012-13	**127**	IP-	Polar Guard Advance	8	115	20		9.18%	-20.5	-27.1
Winter 2018-19	**14**	IP-	Other PG Fluid	8	115	20	115 kts for PG	8.77%	-20.7	-20.2
Winter 2010-11	***23***	*IP-*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED*	*7.20%*	*-21.5*	*-23.6*
Winter 2012-13	**129**	IP-	Other PG Fluid	8	115	20		7.14%	-22.5	-27.8
Winter 2012-13	**137**	IP-	Other PG Fluid	8	115	20	15 min. delay to run tunnel after contamination; valve frozen	6.71%	-22.7	-24.7
Winter 2010-11	***35***	*IP-*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED - Last Minute Change to 115 Kts Due to Cont.*	*6.35%*	*-23.2*	*-27.6*

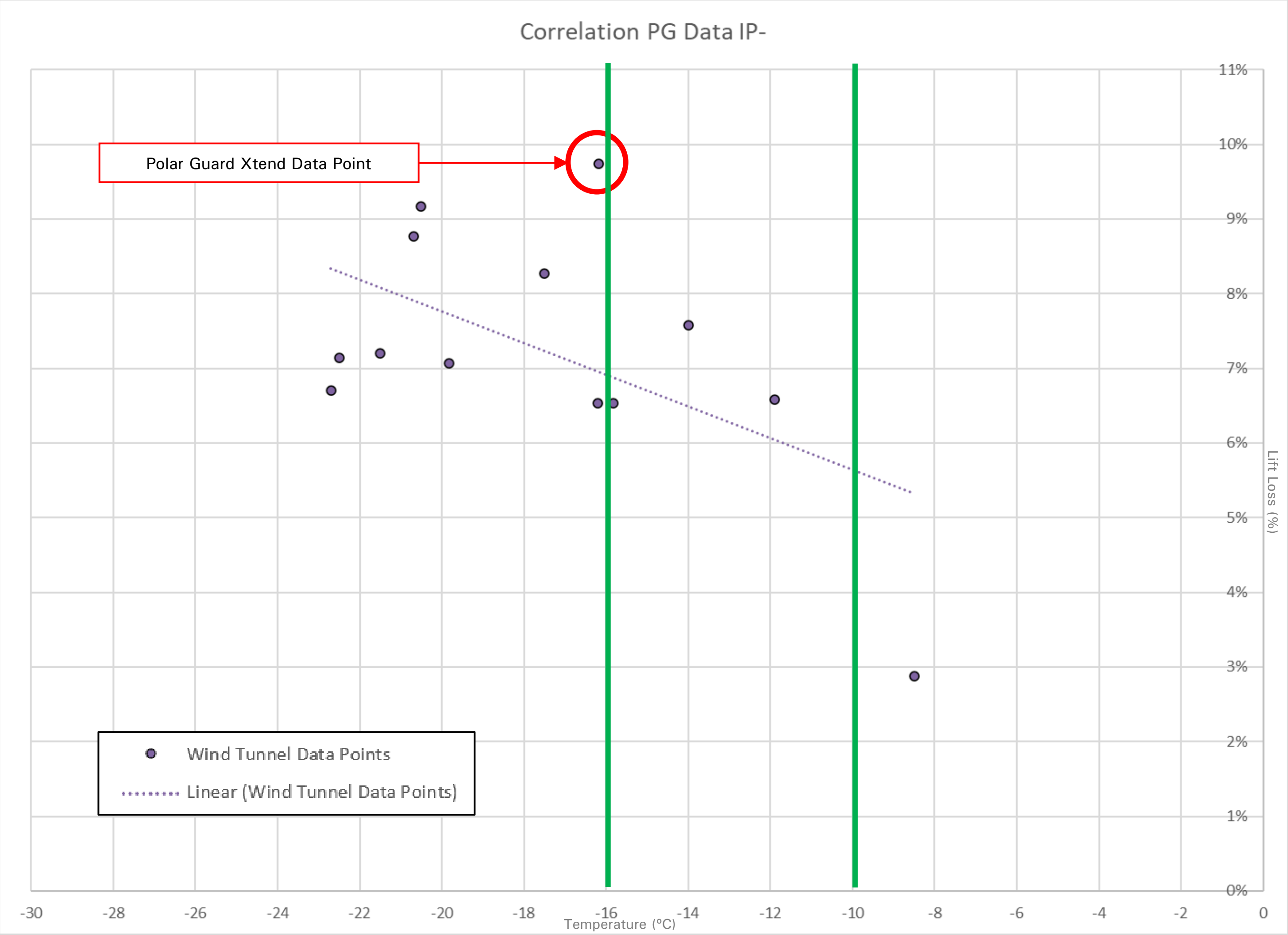


Figure 4.2: Correlation of PG Data for IP- Below -10°C to -16°C

Table 4.7: Historical PG Data for IP Moderate Below -10°C to -16°C

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)
Winter 2010-11	***15A***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*Repeat of Previous Test Due to Ramp-up Issue*	*3.09%*	*-10.4*	*-12.8*
Winter 2010-11	***15***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*Same As P30 But With different fluid*	*4.71%*	*-10.8*	*-13.3*
Winter 2010-11	***15B***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*Repeat of Test 15 Due to Ramp-up Issue*	*5.27%*	*-10.8*	*-12.7*
Winter 2013-14	**359**	IP Mod	Other PG Fluid	8	115	20	Repeat of 358	7.31%	-10.9	-14.1
Winter 2013-14	**361**	IP Mod	Other PG Fluid	8	115	20	run @ LOUT	5.08%	-10.9	-11
Winter 2013-14	**362**	IP Mod	Polar Guard Advance	8	115	20	run @ LOUT	6.01%	-11	-10.9
Winter 2013-14	**360**	IP Mod	Other PG Fluid	8	115	20	run @ LOUT	6.95%	-12.1	-12.3
Winter 2013-14	**358**	IP Mod	Other PG Fluid	8	115	20	Data lost due to APM unit	N/A	-12.2	-16.9
Winter 2018-19	**23**	IP Mod	Other PG Fluid	8	115	20	115 kts for PG	6.30%	-13.35	-15.1
Winter 2012-13	**113A**	IP Mod	Other PG Fluid	8	115	20	Repeat of 113	8.83%	-13.4	-18.7
Winter 2018-19	**22**	IP Mod	Other PG Fluid	8	115	20	115 kts for PG	7.18%	-13.5	-14.9
Winter 2012-13	**113**	IP Mod	Other PG Fluid	8	115	20	Ramp-up too slow close to 40 secs	7.31%	-13.7	-19.2
Winter 2012-13	**95**	IP Mod	Other PG Fluid	8	115	20	Didn't reach 115 kts	7.44%	-13.8	-18.5
Winter 2013-14	**357**	IP Mod	Other PG Fluid	8	115	20	run @ LOUT	7.16%	-14	-17.9
Winter 2012-13	**92**	IP Mod	Polar Guard Advance	8	115	20	Didn't reach 115 kts	8.05%	-14.4	-19.1
Winter 2010-11	***41A***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED - Same As Test 25 but at 115 Kts*	*5.63%*	*-15.4*	*-20.6*
Winter 2015-16	**14**	IP Mod	Other PG Fluid	8	115	20	-	8.45%	-15.8	-17.2
Winter 2013-14	**331**	IP Mod	Other PG Fluid	8	115	20	new dispenser	8.95%	-16.3	-20.2
Winter 2013-14	**333**	IP Mod	Other PG Fluid	8	115	20	new dispenser	9.42%	-16.4	-20.6
Winter 2010-11	***41***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED - Same As Test 25 but at 115 Kts*	-	*-16.5*	*-20.6*
Winter 2020-21	**115**	IP Mod	Polar Guard Xtend	8	115	20	115 kts for PG	9.79%	-16.72	-16.9
Winter 2012-13	**156**	IP Mod	Other PG Fluid	8	115	20		9.06%	-16.8	-21.1
Winter 2013-14	**332**	IP Mod	Other PG Fluid	8	115	20	old dispenser	9.25%	-17	-20.6
Winter 2017-18	**22**	IP Mod	Other PG Fluid	8	115	20	115 kts for PG	8.79%	-17.0	-17.7

Table 4.7: Historical PG Data for IP Moderate Below -10°C to -16°C (cont'd)

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)
Winter 2012-13	**150**	IP Mod	Polar Guard Advance	8	115	20	LOWV sample	6.65%	-17.1	-20
Winter 2012-13	**149**	IP Mod	Polar Guard Advance	8	115	20		9.24%	-17.2	-19.7
Winter 2013-14	**330**	IP Mod	Other PG Fluid	8	115	20	old dispenser	7.67%	-18.1	-20
Winter 2013-14	**334**	IP Mod	Other PG Fluid	8	115	20	old dispenser	10.82%	-18.8	-20.9
Winter 2013-14	**336**	IP Mod	Other PG Fluid	8	115	20	old dispenser	9.35%	-19.6	-21.4
Winter 2012-13	**121**	IP Mod	Other PG Fluid	8	115	20		6.56%	-19.9	-24
Winter 2013-14	**335**	IP Mod	Other PG Fluid	8	115	20	new dispenser	9.55%	-20	-21
Winter 2013-14	**340**	IP Mod	Polar Guard Advance	8	115	20	run @ LOUT	6.37%	-21.4	-22.8
Winter 2012-13	**134**	IP Mod	Other PG Fluid	8	115	20		5.38%	-22.1	-25
Winter 2012-13	**128**	IP Mod	Polar Guard Advance	8	115	20		8.78%	-22.4	-27.5
Winter 2012-13	**130**	IP Mod	Other PG Fluid	8	115	20		8.08%	-22.6	-28
Winter 2012-13	**141**	IP Mod	Other PG Fluid	8	115	20		6.82%	-22.6	-25.6
Winter 2010-11	***31***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED*	*10.41%*	*-22.8*	*-27.2*
Winter 2012-13	**142**	IP Mod	Other PG Fluid	8	115	20		6.66%	-22.8	-25.5
Winter 2010-11	***38***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED - Repeat Due to Run 31 Fast Ramp. Need Slower*	*10.20%*	*-24.2*	*-28.3*
Winter 2010-11	***28***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED*	*7.56%*	*-24.5*	*-27.3*
Winter 2010-11	***37***	*IP Mod*	Other PG Fluid	*8*	*115*	*20*	*LE TRIP INSTALLED - Change to 115 to Match Current Guidance*	*9.70%*	*-24.5*	*-28.5*

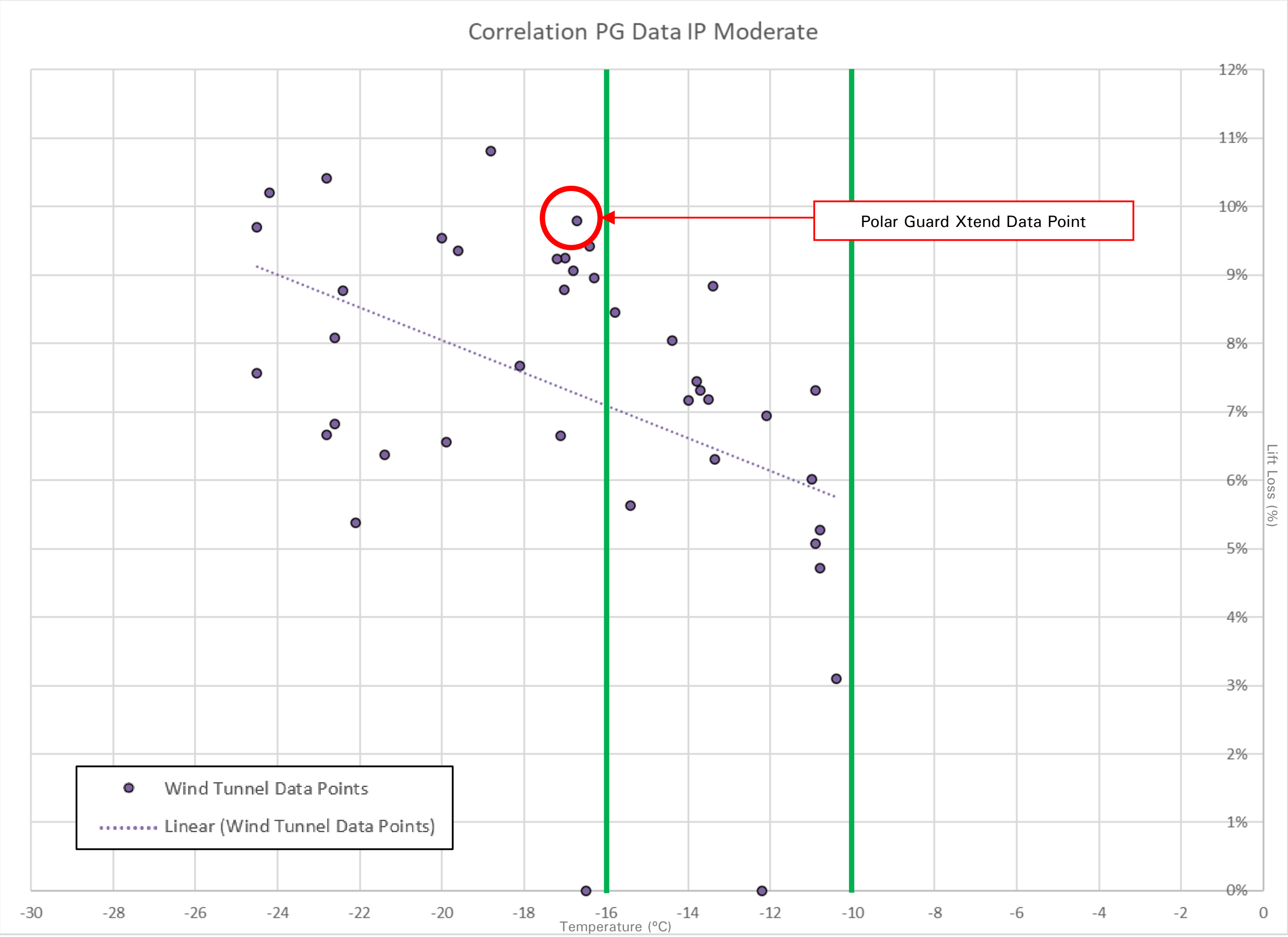


Figure 4.3: Correlation of PG Data for IP Moderate Below -10°C to -16°C

Table 4.8: Historical PG Fluid Only Data at All Temperatures

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0º, 20º)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (ºC)	OAT Before Test (ºC)
Winter 2011-12	**116**	Fluid Only	Other PG Fluid	8	100			5.80%	-1.4	-5.1
Winter 2011-12	**115**	Fluid Only	Other PG Fluid	8	100			5.38%	-1.6	-5.1
Winter 2011-12	**159**	Fluid Only	Other PG Fluid	8	100			4.68%	-1.7	-6.9
Winter 2011-12	**160**	Fluid Only	Other PG Fluid	8	100			4.73%	-1.7	-6.8
Winter 2011-12	**156**	Fluid Only	Other PG Fluid	8	100			4.96%	-2.1	-7.2
Winter 2011-12	**158**	Fluid Only	Other PG Fluid	8	100			4.77%	-2.2	-7
Winter 2011-12	**155**	Fluid Only	Other PG Fluid	8	100			4.59%	-2.3	-7.3
Winter 2011-12	**157**	Fluid Only	Other PG Fluid	8	100			4.62%	-2.4	-7.0
Winter 2020-21	**4**	Fluid Only	Polar Guard Xtend	8	100	20	Baseline Test	6.38%	-3.26	-6.3
Winter 2010-11	***61***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED - Target OAT -5 Instead of 0*	*4.49%*	*-3.5*	*-7.3*
Winter 2011-12	**147**	Fluid Only	Other PG Fluid	8	100			4.14%	-3.6	-7.6
Winter 2010-11	***60***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED - Target OAT -5 Instead of 0*	*4.71%*	*-4.2*	*-7.4*
Winter 2010-11	***63***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Target OAT -5 Instead of 0*	*5.34%*	*-4.5*	*-7.3*
Winter 2009-10	**29**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test for Run 28 (P3)	4.71%	-4.8	-8.5
Winter 2010-11	***62***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Target OAT -5 Instead of 0. LE Trip Removed*	*5.06%*	*-4.9*	*-7.4*
Winter 2011-12	**180**	Fluid Only	Other PG Fluid	8	100			5.23%	-5.4	-10.8
Winter 2011-12	**179**	Fluid Only	Other PG Fluid	8	100			4.88%	-5.6	-10.1
Winter 2009-10	**1**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test for Run 0 (P8)	4.59%	-5.7	-6.6
Winter 2010-11	***75***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Temp. Changed to -5*	*7.45%*	*-5.8*	*-8.9*
Winter 2011-12	**182**	Fluid Only	Other PG Fluid	8	100			5.53%	-6.8	-11.4
Winter 2011-12	**181**	Fluid Only	Other PG Fluid	8	100			5.21%	-7.7	-11.2
Winter 2012-13	**169**	Fluid Only	Other PG Fluid	8	100	20	FLUSH MOUNTED SENSOR INSTALLED	5.64%	-8.6	-11.9
Winter 2017-18	**29**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	5.81%	-9.6	-11.8
Winter 2010-11	***57***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*6.85%*	*-9.9*	*-14.5*

Table 4.8: Historical PG Fluid Only Data at All Temperatures (cont'd)

Test Year	Test #	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0º, 20º)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° C_L vs Dry C_L	Tunnel Temp. Before Test (ºC)	OAT Before Test (ºC)
Winter 2010-11	***5A***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Repeat of Previous Test*	*3.87%*	*-10.4*	*-12.4*
Winter 2010-11	***55***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*2.57%*	*-11.4*	*-15*
Winter 2010-11	***54***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*5.78%*	*-12.1*	*-15.4*
Winter 2011-12	**56**	Fluid Only	Other PG Fluid	8	100			5.43%	-12.4	-15.7
Winter 2011-12	**54**	Fluid Only	Other PG Fluid	8	100			6.02%	-12.9	-16.4
Winter 2018-19	**24**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	7.53%	-13.65	-15.0
Winter 2010-11	***12***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Comparative Run for E2*	*6.05%*	*-14.2*	*-16*
Winter 2010-11	***81***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*Repeat of Test 80 with 8 Degree Rotation*	*7.10%*	*-14.7*	*-18*
Winter 2010-11	***42***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*3.57%*	*-15.7*	*-20.5*
Winter 2010-11	***39***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*7.20%*	*-16*	*-21.1*
Winter 2020-21	**114**	Fluid Only	Polar Guard Xtend	8	100	20	Baseline Test	7.00%	-16.23	-16.8
Winter 2017-18	**23**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	6.05%	-16.7	-17.7
Winter 2012-13	**155**	Fluid Only	Other PG Fluid	8	100	20		6.40%	-17.8	-21
Winter 2010-11	***21***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*6.56%*	*-18.2*	*-20.4*
Winter 2018-19	**9**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	8.90%	-22.3	-22.6
Winter 2018-19	**7**	Fluid Only	Polar Guard Advance	8	100	20	Baseline Test	6.94%	-22.4	-22.3
Winter 2010-11	***32***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*3.92%*	*-22.5*	*-27.1*
Winter 2018-19	**4**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	6.99%	-22.6	-22.3
Winter 2018-19	**5**	Fluid Only	Other PG Fluid	8	100	20	Baseline Test	9.38%	-22.6	-22.2
Winter 2012-13	**135**	Fluid Only	Other PG Fluid	8	100	20		3.99%	-22.6	-5
Winter 2012-13	**143**	Fluid Only	Other PG Fluid	8	100	20		6.21%	-23.1	-25.4
Winter 2012-13	**146**	Fluid Only	Polar Guard Advance	8	100	20		7.99%	-23.3	-25.5
Winter 2010-11	***30***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*8.13%*	*-23.5*	*-27.1*
Winter 2010-11	***29***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*6.56%*	*-23.9*	*-27.4*
Winter 2010-11	***33***	*Fluid Only*	Other PG Fluid	*8*	*100*	*20*	*LE TRIP INSTALLED*	*8.27%*	*-24.1*	*-27.4*

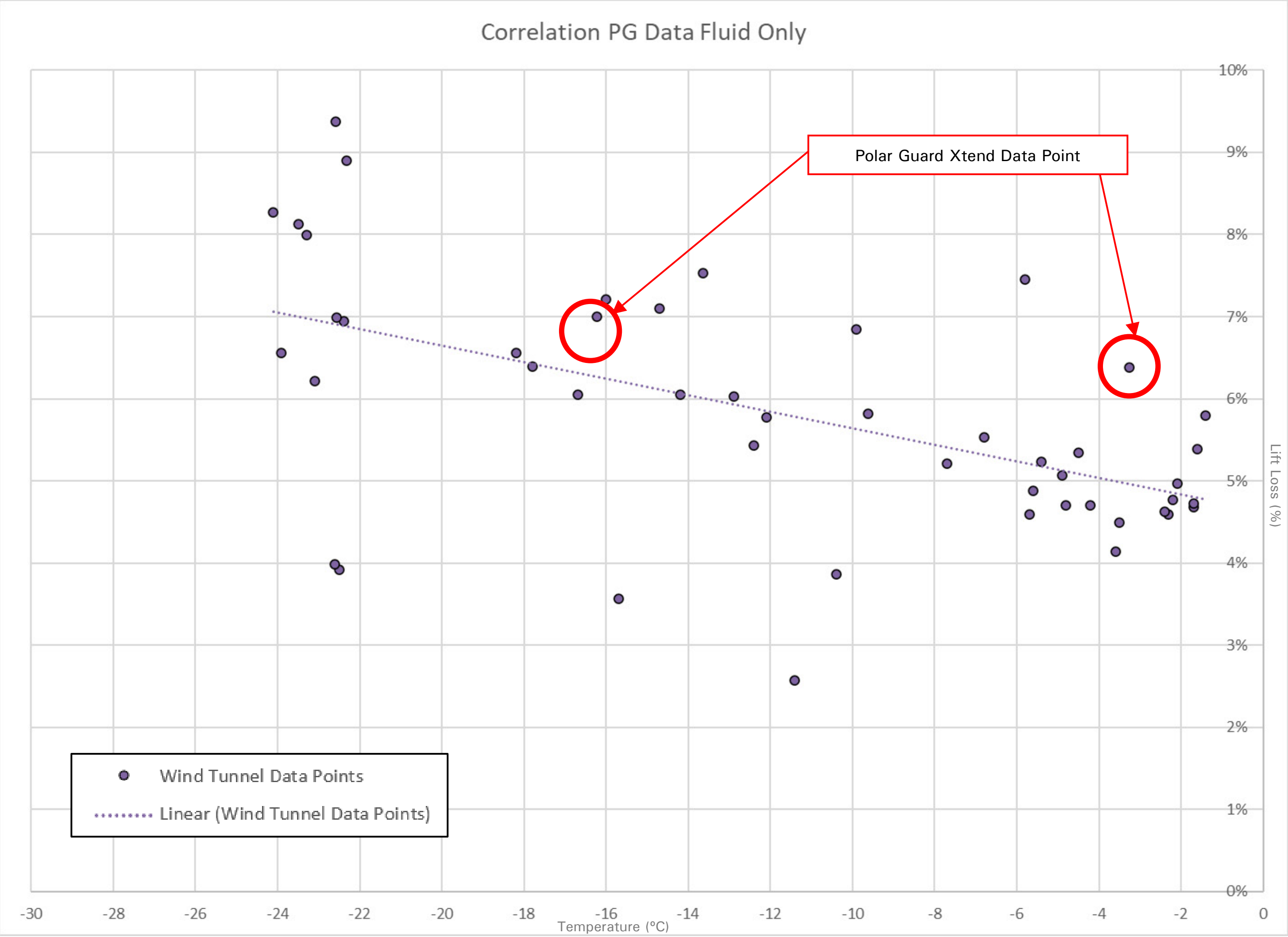
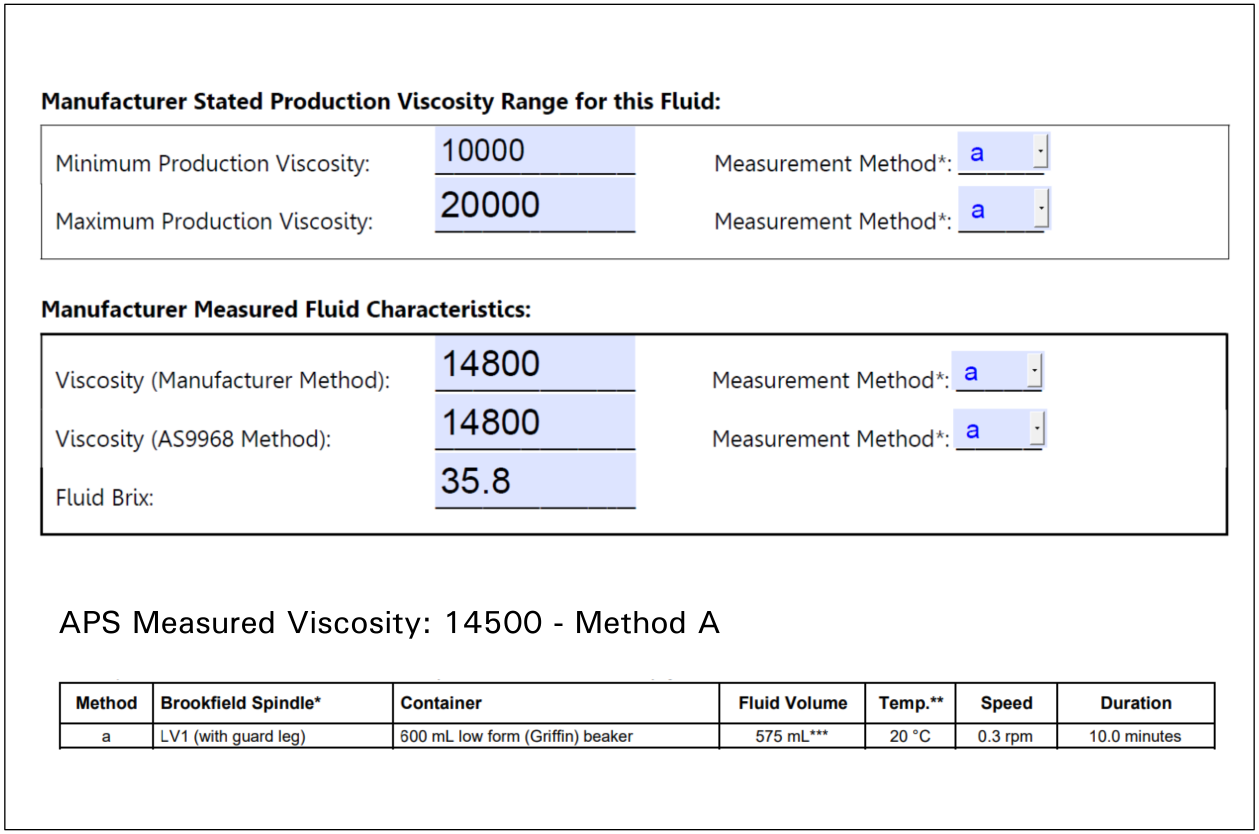


Figure 4.4: Correlation of PG Data Fluid Only Data at All Temperatures



Manufacturer Stated Production Viscosity Range for this Fluid:

Minimum Production Viscosity: 10000 Measurement Method*: a

Maximum Production Viscosity: 20000 Measurement Method*: a

Manufacturer Measured Fluid Characteristics:

Viscosity (Manufacturer Method): 14800 Measurement Method*: a

Viscosity (AS9968 Method): 14800 Measurement Method*: a

Fluid Brix: 35.8

APS Measured Viscosity: 14500 - Method A

Method	Brookfield Spindle*	Container	Fluid Volume	Temp.**	Speed	Duration
a	LV1 (with guard leg)	600 mL low form (Griffin) beaker	575 mL***	20 °C	0.3 rpm	10.0 minutes

Figure 4.5: Polar Guard Xtend Viscosity (Cp) Information

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5. POSSIBLE EXTENSION OF ALLOWANCE TIMES FOR EG FLUIDS

Type IV Ice Pellet Allowance Times are intended to be conservative, and, therefore, generic guidance is developed based on data collected using commercially available Type IV fluids. Historically, Type IV PG and EG fluids have been grouped together; however, data has indicated that EG fluids may have the operational advantage of longer Ice Pellet Allowance Times in specific conditions. The industry requested that EG fluid-specific Ice Pellet Allowance Time Tables be investigated to determine potentially longer allowance times specific to these fluids. As such, an analysis of historical EG data was conducted, and some additional testing with EG fluids was performed.

5.1 Analysis of EG Fluid Allowance Times

An analysis was conducted based on the EG fluids tested during the winter of 2020-21, as well as on historical testing that occurred between 2009 and 2020. The data includes 135 tests, which comprised allowance time development, validation, and expansion tests. The analysis included seven EG fluids:

1. AllClear Systems LLC ClearWing EG;
2. CHEMCO Inc. ChemR EG IV;
3. Clariant Produkte (Deutschland) GmbH Max Flight AVIA;
4. Clariant Produkte (Deutschland) GmbH Safewing EG IV NORTH;
5. Dow Chemical Company UCAR™ Endurance EG106 De/Anti-Icing Fluid;
6. JSC RCP Nordix (Formerly Oksayd Co. Ltd.) Defrost EG 4; and
7. LNT Solutions LNT E450.

The detailed data for all EG tests conducted since 2009 with the RJ wing has been reviewed and a copy has been included in Appendix E for reference (refer to Subsection 3.1 for heading descriptions). Table 5.1 provides a summary of all data points, including those tested to the allowance time and those tested to exposure times longer than the current allowance time. Table 5.2 includes only the validation tests (i.e., tests that were run to the current allowance time). Table 5.3 includes only the tests that were run longer than the current allowance time or in conditions where there are no allowance times.

For tests highlighted in yellow or red (review or bad), comments were included describing the reason for the rating. A new colour, pink, was added this year for tests that demonstrated adherence on the flap while configured with the flap extended. The tests highlighted in pink are expected to have achieved the status of “Review” or “Good” had the test been re-run with the flap configured in the retracted position.

For Table 5.1, Table 5.2, and Table 5.3, the individual test information has been included in the following format.

- FFAA(BB)CC[DD]GGE
    - FF is the fluid name designation based on the following:
        - AllClear ClearWing EG – CW;
        - Chemco ChemR EG IV – CC;
        - Clariant Avia – CA;
        - Clariant North – CN;
        - Dow EG106 – DE;
        - LNT E450 – LE; and
        - Defrost EG IV – FR.
    - AA is the static tunnel ambient temperature recorded just before the start of the simulated takeoff test, measured in degrees Celsius and rounded to the closest degree.
    - BB is the percent Lift Loss calculated based on the comparison of the 8º lift coefficient during the test run versus the dry wing average lift coefficient.
    - CC is the exposure time of the test in minutes.
    - DD is the test number for referencing the data in the test logs.
    - GG is the last two digits of the year of testing (i.e., 2020-21 is “21”).
    - E is the status of the testing, either “G” for good, “R” for review, or “B” for bad, as per the guidelines. The highlighting is in a corresponding green, yellow, or red colour. A new colour, pink, was added this year for tests that demonstrated adherence on the flap after contamination had been applied with the flap extended. The tests highlighted in pink are expected to have achieved the status of “Review” or “Good” had the test been re-run with the flap configured in the retracted position during exposure to contamination.
    - The test information is included in the cell for which the temperature band best corresponds to the temperature recorded during the test.

Table 5.1: All EG Fluid Data Collected since 2009 with RJ Wing

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16°C**
Light Ice Pellets	50 minutes CW0(1.4)50[10]21G DE-4(0.9)50[22]10G CW-4(2.6)70[99]21G CN-5(0.8)70[19]20G CA-5(1.3)70[103]21G FR-6(3.3)70[58]21G DE-6(3.1)70[104]21G CC-7(2.2)70[57]21G	30 minutes CC-7(1.3)50[40]18G CC-9(1.8)50[31]18G CW-8(2.7)50[49]21G CA-10(2.5)50[48]21G	30 minutes DE-11(1.6)30[51]11G DE-13(1.1)30[67]10G CC-13(2.6)30[16]18G CN-14(2.5)30[4]20G LE-15(5.8)30[10]16R CN-16(2.8)50[7]20G	30 minutes DE-17(2.3)30[80]10G CA-21(5.7)30[15]19R FR-22(6.7)30[17]19R DE-23(3.2)30[27]11G
Light Ice Pellets Mixed with Snow	40 minutes DE-3(1.2)40[23]10G CW-5(2.8)40[39]21G CA-3(2.3)50[72]21G FR-3(3.4)50[97]21G CW-3(3.3)50[98]21R DE-4(3.2)50[71]21G CC-5(3.7)50[33]18R CN-5(1.5)50[20]20G	15 minutes LE-7(5.4)15[21]16G CC-8(2.5)15[12]18G CA-9(3.4)30[62]21G CW-9(4.9)30[63]21G DE-10(3.6)30[64]21G	15 minutes CC-12(3.4)15[17]18G FR-13(5.2)15[42]19G DE-13(2.4)15[45]11G CA-14(4.3)15[41]19R CN-15(2.8)15[5]20G CC-14(3.2)30[12]20G DE-14(1.9)30[14]20G DE-14(2.7)25[78]11G FR-15(3.4)30[16]20G	0 minutes DE-17(2.0)15[310]14G DE-18(4.1)15[311]14R
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes CN-2(6.9)40[90]21R FR-2(3.9)40[91]21R CW-2(7.8)40[92]21B	10 minutes CC-6(5.4)30[32]18R CW-9(6.7)30[80]21B CA-10(5.6)30[79]21B		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes LE-1(3.1)25[68]16G DE-2(4.1)25[26]10B DE-3(1.3)25[26A]10G CW-6(7.3)25[40]21B CW-6(1.6)25[41]21G*- CW-2(6.5)40[73]21B CC-2(9.9)40[74]21B CC-2(12.8)35[75]21B CC-3(2.3)40[76]21R- CN-5(4.7)40[22]20B FR-7(5.8)40[106]21B CA-8(5.8)40[59]21B CC-8(7.1)40[107]21B(old batch) CC-9(8.0)40[108]21B	10 minutes DE-7(1.2)10[98]10G LE-8(4.9)10[20]16G CC-8(3.2)10[8]18G FR-10(4.4)10[43]19G CA-10(2.9)10[46]19G DE-10(7.2)40[126]11B CN-10(5.1)30[65]21B CC-11(7.5)30[67]21B	0 minutes CA-11(7.0)30[66]21B CC-12(5.8)30[43]18B	
Light Ice Pellets Mixed with Rain	25 minutes FR1(1.4)25[36]19G LE0(4.3)25[76]16G CW0(3.1)25[23]21B*			
Moderate Ice Pellets (or Small Hail)	25 minutes LE-2(3.3)25[69]16G DE-4(0.8)25[21]10G DE-4(1.8)25[124]12G DE-4(1.7)25[125]12G CA-4(1.9)25[31]19G FR-4(2.5)25[32]19G CW-5(2.0)25[38]21G FR-4(3.2)35[95]21G CC-4(2.7)35[96]21R CN-5(1.3)35[21]20R CA-6(2.1)35[55]21G DE-7(1.9)35[56]21G CW-8(2.2)35[42]21R	10 minutes CC-10(1.9)10[13]18G DE-8(2.2)25[50]21G CA-9(3.3)25[51]21G CC-10(2.3)25[42]18G	10 minutes CN-13(2.4)10[3]20G LE-15(6.4)10[13]16R CC-15(2.7)10[18]18G CC-14(2.1)25[11]20R DE-15(1.1)25[13]20R CN-16(2.2)25[6]20R FR-16(2.8)25[15]20G	10 minutes LE-17(6.0)10[11]16R DE-18(1.8)10[71]10G DE-21(3.1)10[26]11G CA-21(5.5)10[16]19R FR-21(6.6)10[18]19R

Table 5.1: All EG Fluid Data Collected since 2009 with RJ Wing (cont'd)

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16°C**
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes CN-5(0.8)20[23]20G CA-4(3.6)20[86]21G DE-4(7.4)25[87]21B CW-3(7.1)20[88]21B CC-3(7.3)20[100]21R FR-7(3.6)20[105]21R	7 minutes CC-8(2.4)7[9]18G DE-10(2.6)10[81]21G CN-9(4.0)15[82]21G CA-9(3.4)15[83]21G	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes CC-3(7.2)10[39]18B CW2(1.0)20[32]21G CC2(2.3)15[26]21G* DE2(1.9)20[30]21G DE2(1.9)15[31]21G DE1(1.9)15[27]21G* FR1(2.3)20[33]21B FR1(1.6)20[34]21B- FR1(2.3)15[35]21R CW0(13.0)20[13]21B* CA0(3.2)15[17]21G* FR0(5.4)15[18]21B* DE-1(11.7)15[19]21B* DE-1(5.9)15[20]21B*- DE-1(2.1)12[21]21R*- CN-1(6.7)15[22]21B* CW-1(7.1)15[14]21B*			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

Table 5.2: EG Validation Tests (Meet Current ATs) since 2009 with RJ Wing

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16°C**
Light Ice Pellets	50 minutes CW0(1.4)50[10]21G DE-4(0.9)50[22]10G	30 minutes CW-8(2.7)50[49]21G	30 minutes DE-11(1.6)30[51]11G DE-13(1.1)30[67]10G CC-13(2.6)30[16]18G CN-14(2.5)30[4]20G LE-15(5.8)30[10]16R	30 minutes DE-17(2.3)30[80]10G CA-21(5.7)30[15]19R FR-22(6.7)30[17]19R DE-23(3.2)30[27]11G
Light Ice Pellets Mixed with Snow	40 minutes DE-3(1.2)40[23]10G CW-5(2.8)40[39]21G	15 minutes LE-7(5.4)15[21]16G CC-8(2.5)15[12]18G CW-9(4.9)30[63]21G	15 minutes CC-12(3.4)15[17]18G FR-13(5.2)15[42]19G DE-13(2.4)15[45]11G CA-14(4.3)15[41]19R CN-15(2.8)15[5]20G	0 minutes
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes CW0(3.1)25[23]21B* LE-1(3.1)25[68]16G DE-2(4.1)25[26]10B CW-2(6.5)40[73]21B DE-3(1.3)25[26A]10G CW-6(7.3)25[40]21B CW-6(1.6)25[41]21G*-	10 minutes DE-7(1.2)10[98]10G LE-8(4.9)10[20]16G CC-8(3.2)10[8]18G FR-10(4.4)10[43]19G CA-10(2.9)10[46]19G	0 minutes	
Light Ice Pellets Mixed with Rain	25 minutes FR1(1.4)25[36]19G CW0(3.1)25[23]21B LE0(4.3)25[76]16G			
Moderate Ice Pellets (or Small Hail)	25 minutes LE-2(3.3)25[69]16G DE-4(0.8)25[21]10G DE-4(1.8)25[124]12G DE-4(1.7)25[125]12G CA-4(1.9)25[31]19G FR-4(2.5)25[32]19G CW-5(2.0)25[38]21G CW-8(2.2)35[42]21R	10 minutes DE-7(1.6)10[364]14B CC-10(1.9)10[13]18G	10 minutes CN-13(2.4)10[3]20G LE-15(6.4)10[13]16R CC-15(2.7)10[18]18G	10 minutes LE-17(6.0)10[11]16R DE-18(1.8)10[71]10G DE-21(3.1)10[26]11G CA-21(5.5)10[16]19R FR-21(6.6)10[18]19R

Table 5.2: EG Validation Tests (Meet Current ATs) since 2009 with RJ Wing (cont'd)

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16°C**
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes	7 minutes CC-8(2.4)7[9]18G	**Caution:** **No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes CW2(1.0)20[32]21G CW0(13.0)20[13]21B* CW-1(7.1)15[14]21B* CC-3(7.2)10[39]18B			

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

Table 5.3: EG Expansion Tests (Exceed Current ATs) since 2009 with RJ Wing

Precipitation Type	Outside Air Temperature			
	-5°C and above	Below -5 to -10°C	Below -10 to -16°C	Below -16°C
Light Ice Pellets	50 minutes CW-4(2.6)70[99]21G CN-5(0.8)70[19]20G CA-5(1.3)70[103]21G FR-6(3.3)70[58]21G DE-6(3.1)70[104]21G CC-7(2.2)70[57]21G	30 minutes CC-7(1.3)50[40]18G CW-8(2.7)50[49]21G CC-9(1.8)50[31]18G CA-10(2.5)50[48]21G	30 minutes CN-16(2.8)50[7]20G	30 minutes
Light Ice Pellets Mixed with Snow	40 minutes CA-3(2.3)50[72]21G FR-3(3.4)50[97]21G CW-3(3.3)50[98]21R DE-4(3.2)50[71]21G CC-5(3.7)50[33]18R CN-5(1.5)50[20]20G	15 minutes CA-9(3.4)30[62]21G CW-9(4.9)30[63]21G DE-10(3.6)30[64]21G	15 minutes CC-14(3.2)30[12]20G DE-14(1.9)30[14]20G DE-14(2.7)25[78]11G FR-15(3.4)30[16]20G	0 minutes DE-17(2.0)15[310]14G DE-18(4.1)15[311]14R
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes CN-2(6.9)40[90]21R FR-2(3.9)40[91]21R CW-2(7.8)40[92]21B	10 minutes CC-6(5.4)30[32]18R CW-9(6.7)30[80]21B CA-10(5.6)30[79]21B		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes CW-2(6.5)40[73]21B CC-2(9.9)40[74]21B CC-2(12.8)35[75]21B CC-3(2.3)40[76]21R- CN-5(4.7)40[22]20B FR-7(5.8)40[106]21B CA-8(5.8)40[59]21B CC-8(7.1)40[107]21B(old batch) CC-9(8.0)40[108]21B	10 minutes DE-10(7.2)40[126]11B CN-10(5.1)30[65]21B CC-11(7.5)30[67]21B	0 minutes CA-11(7.0)30[66]21B CC-12(5.8)30[43]18B	
Light Ice Pellets Mixed with Rain	25 minutes See data from "Light Ice Pellets Mixed with Freezing Rain" cell above as it serves as a conservative surrogate			
Moderate Ice Pellets (or Small Hail)	25 minutes FR-4(3.2)35[95]21G CC-4(2.7)35[96]21R CN-5(1.3)35[21]20R CA-6(2.1)35[55]21G DE-7(1.9)35[56]21G CW-8(2.2)35[42]21R	10 minutes DE-8(2.2)25[50]21G CA-9(3.3)25[51]21G CC-10(2.3)25[42]18G	10 minutes CC-14(2.1)25[11]20R DE-15(1.1)25[13]20R CN-16(2.2)25[6]20R FR-16(2.8)25[15]20G	10 minutes

Table 5.3: EG Expansion Tests (Exceed Current ATs) since 2009 with RJ Wing (cont'd)

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16°C**
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	10 minutes CW-3(7.1)20[88]21B CC-3(7.3)20[100]21R CA-4(3.6)20[86]21G DE-4(7.4)25[87]21B CN-5(0.8)20[23]20G FR-7(3.6)20[105]21R	7 minutes CN-9(4.0)15[82]21G CA-9(3.4)15[83]21G DE-10(2.6)10[81]21G		
Moderate Ice Pellets (or Small Hail) Mixed with Rain	10 minutes DE2(1.9)20[30]21G CC2(2.3)15[26]21G* DE2(1.9)15[31]21G CW2(1.0)20[32]21G FR1(2.3)20[33]21B FR1(1.6)20[34]21B- FR1(2.3)15[35]21R DE1(1.9)15[27]21G* CA0(3.2)15[17]21G* FR0(5.4)15[18]21B* CW0(13.0)20[13]21B* CW-1(7.1)15[14]21B* DE-1(11.7)15[19]21B* DE-1(5.9)15[20]21B*- DE-1(2.1)12[21]21R*- CN-1(6.7)15[22]21B*	**Caution: No allowance times currently exist**		

*Rate issue with sprayer scanner. Rain rate was about 20 percent higher than expected.

- Flap up test.

5.3 Proposed Changes for an EG Specific Allowance Time Table

Based on the results, each cell of the allowance time table was analysed for EG tests showing room for expansion. The basis for expansion could include the following:

- Test ran longer than current allowance time that had "Good" status;
- Test ran longer than current allowance time that had "Review" or "Bad" status that could be justified (i.e., flap down during exposure leading to bad visuals);
- Test ran to the current allowance time that had "Good" status indicating margin for longer time; and
- Test ran to the current allowance time that had "Review" or "Bad" status that could be justified (i.e., flap down during exposure leading to bad visuals), therefore indicating margin for longer time.

The longest times supported by the data available were considered new potential allowance times. Table 5.4 presents a summary of the potential longer allowance times for EG fluids based on the data collected to date. Table 5.5 shows the data summarized as potential percentage increases for longer allowance times.

Table 5.4: Analysis of Potential Longer Allowance Times Based on Current EG Fluid Tests Data

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	~~50 minutes~~ 70 minutes	~~30 minutes~~ 50 minutes	30 minutes limited data	30 minutes
Light Ice Pellets Mixed with Snow	~~40 minutes~~ 50 minutes	~~15 minutes~~ 30 minutes	15 minutes limited data	
Light Ice Pellets Mixed with Freezing Drizzle	~~25 minutes~~ 40 minutes	~~10 minutes~~ 30 minutes	**Caution:** **No allowance times currently exist**	
Light Ice Pellets Mixed with Freezing Rain	~~25 minutes~~ 40 minutes	~~10 minutes~~ 30 minutes		
Light Ice Pellets Mixed with Rain	~~25 minutes~~ 40 minutes			
Moderate Ice Pellets (or Small Hail)	~~25 minutes~~ 35 minutes	~~10 minutes~~ 25 minutes	10 minutes limited data	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	~~10 minutes~~ 20 minutes	~~7 minutes~~ 10 minutes	**Caution:** **No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	~~10 minutes~~ 15 minutes			

Table 5.5: Analysis of Potential Percentage Increase in Allowance Times

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16 to -22°C**
Light Ice Pellets	40%	67%	-	-
Light Ice Pellets Mixed with Snow	25%	100%	-	
Light Ice Pellets Mixed with Freezing Drizzle	60%	200%	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Freezing Rain	60%	200%		
Light Ice Pellets Mixed with Rain	60%			
Moderate Ice Pellets (or Small Hail)	40%	150%	-	-
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	100%	43%	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	50%			

The data collected to date indicates the potential for longer allowance times specific to EG fluids. The cells recommended are in the above -10ºC range, as much of the supporting testing conducted in 2020-21 was in this temperature range. Although some cells below -10ºC contain historical data supporting a potential expansion, there is not enough data to support a thorough analysis at this time.

The following are some notable observations on the cells to be expanded:

- Each of the cells contains at least three different EG fluid expansion tests. The only exception is Light Ice Pellets Mixed with Rain cell which references the Light Ice Pellets Mixed with Freezing Rain data as a conservative surrogate;
- There does not appear to be any worse-performing EG fluid that could be used as the "worst case fluid";
- Percentage increases in allowance times range from 25 percent to 200 percent;
- Cells contain data that may have "Review" status. These are borderline cases and, considering they are limited, should be acceptable; and
- Tests mixed with freezing precipitation may have "Bad" status tests due to the flap down configuration during the test. Had the test been conducted with the flap up in a properly nested configuration, the results would have improved significantly.

5.3.1 Proposed Changes to the HOT Guidelines

For the Winter 2021-22 HOT Guidelines, TC and the FAA agreed to include a separate Type IV EG fluid allowance time table that incorporates the longer times (as shown in Table 5.4) limited to the -10ºC and above temperature range. The allowance times for the Type IV PG fluids remained unchanged.

There is a potential to develop longer allowance times for Type IV EG fluids below -10ºC; however, additional data is required to support the preliminary data collected to date.

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6. GENERAL CHANGES TO THE ALLOWANCE TIME TABLE

This section describes general changes made to the allowance time table format and contents as a result of wind tunnel testing conducted during the winter of 2020-21.

6.1 Ice Pellets Mixed with Rain Conditions

As part of the testing, results demonstrated that contamination adherence could progress quickly if the testing temperature was 0°C or below during conditions of Light Ice Pellets Mixed with Rain and Moderate Ice Pellets (or Small Hail) Mixed with Rain. For temperatures above 0°C, the progression of adherence was as expected. Some of the EG expansion data (see Table 5.1) collected in this condition during the winter of 2020-21 demonstrated sensitivity of adherence to temperature at this threshold.

As such, it is recommended that Note 4 and Note 8 of the Type IV allowance time table and Note 5 of the Type III allowance time table be reworded to exclude 0°C. This change will also be consistent with the "Rain on a Cold-Soaked Wing Condition" guidance that currently exists. Table 6.1 presents the current and proposed allowance time table notes.

Table 6.1: Proposed Changes to Allowance Time Table Note

Current Note (Notes 4 and 8 for Type IV Table and Note 5 for Type III Table)	**Proposed Note**
"No allowance times exist in this condition for temperatures below 0°C."	"No allowance times exist in this condition for temperatures of 0°C and below."

6.2 METAR Codes for Ice Pellet and Mixed Conditions

Over the years, the ice pellet allowance time tables have developed beyond guidance specific to ice pellets, including mixed conditions as well. Based on industry feedback, it was recommended that the allowance time tables be amended to include the specific METAR codes or combinations for which the allowance times apply. The purpose is to remove ambiguity around which allowance times can or cannot be used in specific conditions.

For the Winter 2021-22 HOT Guidelines, TC and the FAA agreed to include a new column in the Type III and the newly separated Type IV EG and PG allowance time tables, which includes the applicable METAR codes related to each individual ice pellet or mixed condition.

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7. CONCLUSIONS

These conclusions were derived from the testing conducted during the winter of 2020-21.

7.1 Validation Testing for New-to-Market Type IV Fluids

Two new-to-market fluids were testing during the winter of 2020-21.

Results obtained validated the current Type IV allowance times for use with the new-to-market fluid AllClear ClearWing EG.

The validation testing for Cryotech Polar Guard Xtend is considered incomplete. The three problematic data points were at or outside the temperature limits. More testing is recommended before any changes to the guidelines are considered.

7.2 New Type IV EG Specific Allowance Time Table

Type IV EG fluid testing and an analysis of historical data indicated the potential for longer allowance times specific to Type IV EG fluids. For the Winter 2021-22 HOT Guidelines, TC and the FAA agreed to include a separate Type IV EG fluid allowance time table that incorporates the longer times (as shown in Table 5.4) limited to the -10°C and above temperature range. The allowance times for the Type IV PG fluids remained unchanged.

There is a potential to develop longer allowance times for Type IV EG fluids below -10°C; however, additional data is required to support the preliminary data collected to date.

7.3 Ice Pellets Mixed with Rain Conditions

As part of the testing, results demonstrated that fluid adherence could progress quickly if the testing temperature was 0°C or below during conditions of Light Ice Pellets Mixed with Rain and Moderate Ice Pellets (or Small Hail) Mixed with Rain. As such, it is recommended that Note 4 and Note 8 of the Type IV allowance time tables and Note 5 of the Type III allowance time table be reworded to exclude 0°C.

7.4 METAR Codes for Ice Pellet and Mixed Conditions

For the Winter 2021-22 HOT Guidelines, TC and the FAA agreed to include a new column in the Type III and the newly separated Type IV EG and PG allowance time tables, which includes the applicable METAR codes related to each individual ice pellet or mixed condition. The purpose is to remove ambiguity around which allowance times can or cannot be used in specific conditions.

7.5 Changes to Ice Pellet Allowance Time Guidance

The results of the validation and EG expansion testing required changes to the format and contents of the allowance time tables. The proposed changes will result in three separate allowance tables for Type III fluids and the newly separated Type IV EG and Type IV PG fluids. The notes in the respective tables were updated to reflect the latest format and content changes. In addition, a column specifying the applicable METAR codes for each condition was included in the three tables.

8. RECOMMENDATIONS

The following recommendations were compiled based on the work conducted during the winter of 2020-21 and based on consultations with TC and the FAA.

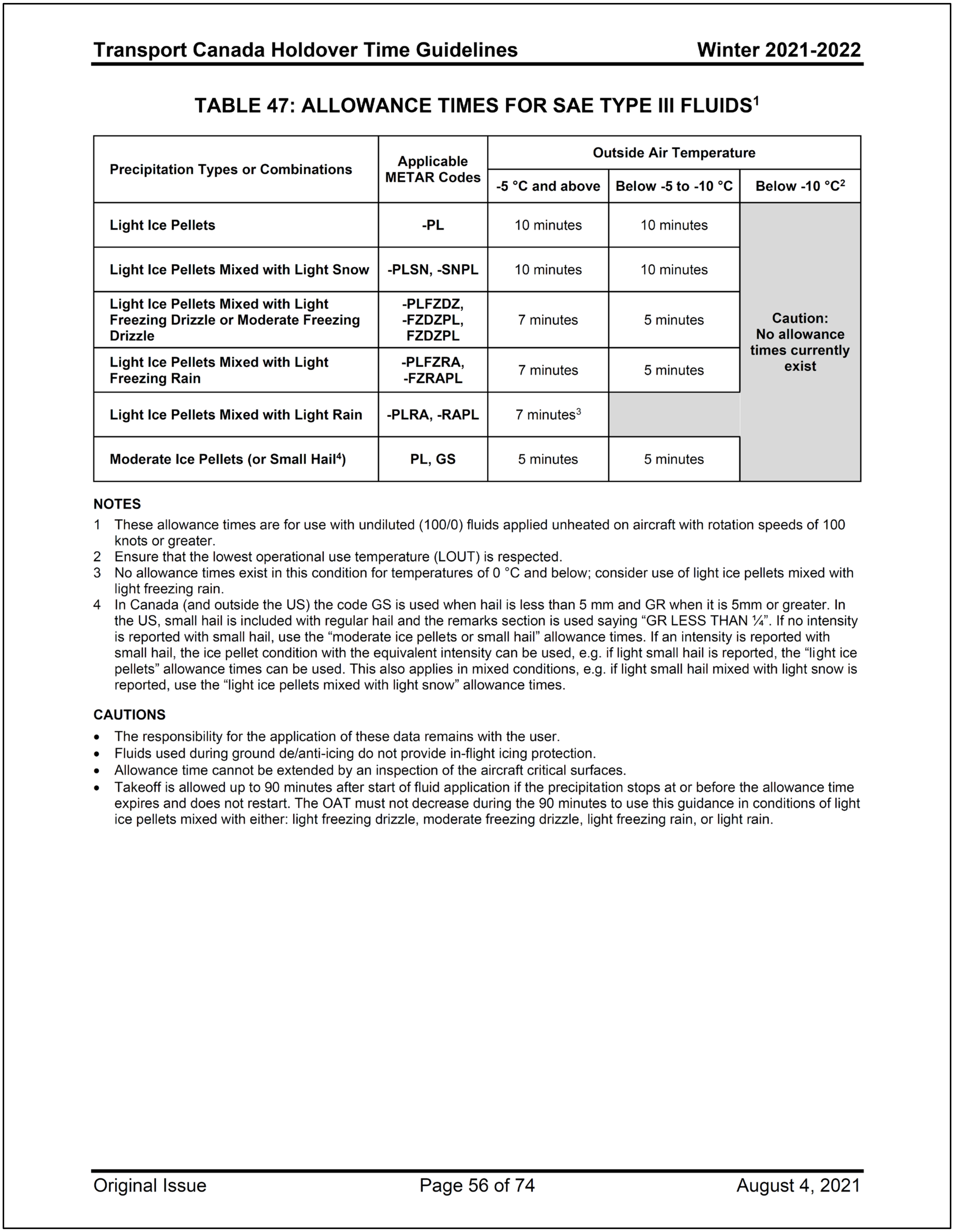
8.1 Changes to Ice Pellet Allowance Time Guidance

The following changes were made to the Ice Pellet Allowance Time guidance material based on the 2020-21 wind tunnel test results.

- The Type IV allowance time table was separated into two tables: EG and PG. The Type IV EG table includes newly developed longer allowance times for conditions above -10°C. The Type IV PG table includes allowance times that remain unchanged compared to the previous year.
- The respective notes and guidance related to the Type IV allowance time tables were updated to reflect the newly separated Type IV EG and PG format.
- A new column was included in the Type III and the newly separated Type IV EG and PG allowance time tables indicating the applicable METAR codes related to each individual ice pellet or mixed condition.
- The notes for Light Ice Pellets Mixed with Rain and Moderate Ice Pellets (or Small Hail) Mixed with Rain were updated to exclude conditions of 0°C. The new note now reads: "No allowance times exist in this condition for temperatures of 0°C and below."

The updated Winter 2021-22 Type III allowance time table is shown in Table 8.1 for TC and Table 8.2 for the FAA. The newly separated Type IV tables for the winter of 2021-22 are shown in Table 8.3 and Table 8.4 for TC and Table 8.5 and Table 8.6 for the FAA. It should be noted that the 90 percent adjusted tables were also published by TC and the FAA for those operations when flaps and slats are deployed prior to de/anti-icing; however, these tables have not been included in this report for brevity.

Table 8.1: 2021-22 TC Type III Ice Pellet Allowance Time Table



Transport Canada Holdover Time Guidelines **Winter 2021-2022**

TABLE 47: ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature		
		-5 °C and above	Below -5 to -10 °C	Below -10 °C[2]
Light Ice Pellets	**-PL**	10 minutes	10 minutes	**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	10 minutes	10 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	**-PLFZDZ, -FZDZPL, FZDZPL**	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Freezing Rain	**-PLFZRA, -FZRAPL**	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Rain	**-PLRA, -RAPL**	7 minutes[3]		
Moderate Ice Pellets (or Small Hail[4])	**PL, GS**	5 minutes	5 minutes	

NOTES

1 These allowance times are for use with undiluted (100/0) fluids applied unheated on aircraft with rotation speeds of 100 knots or greater.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.
4 In Canada (and outside the US) the code GS is used when hail is less than 5 mm and GR when it is 5mm or greater. In the US, small hail is included with regular hail and the remarks section is used saying “GR LESS THAN ¼”. If no intensity is reported with small hail, use the “moderate ice pellets or small hail” allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the “light ice pellets” allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the “light ice pellets mixed with light snow” allowance times.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

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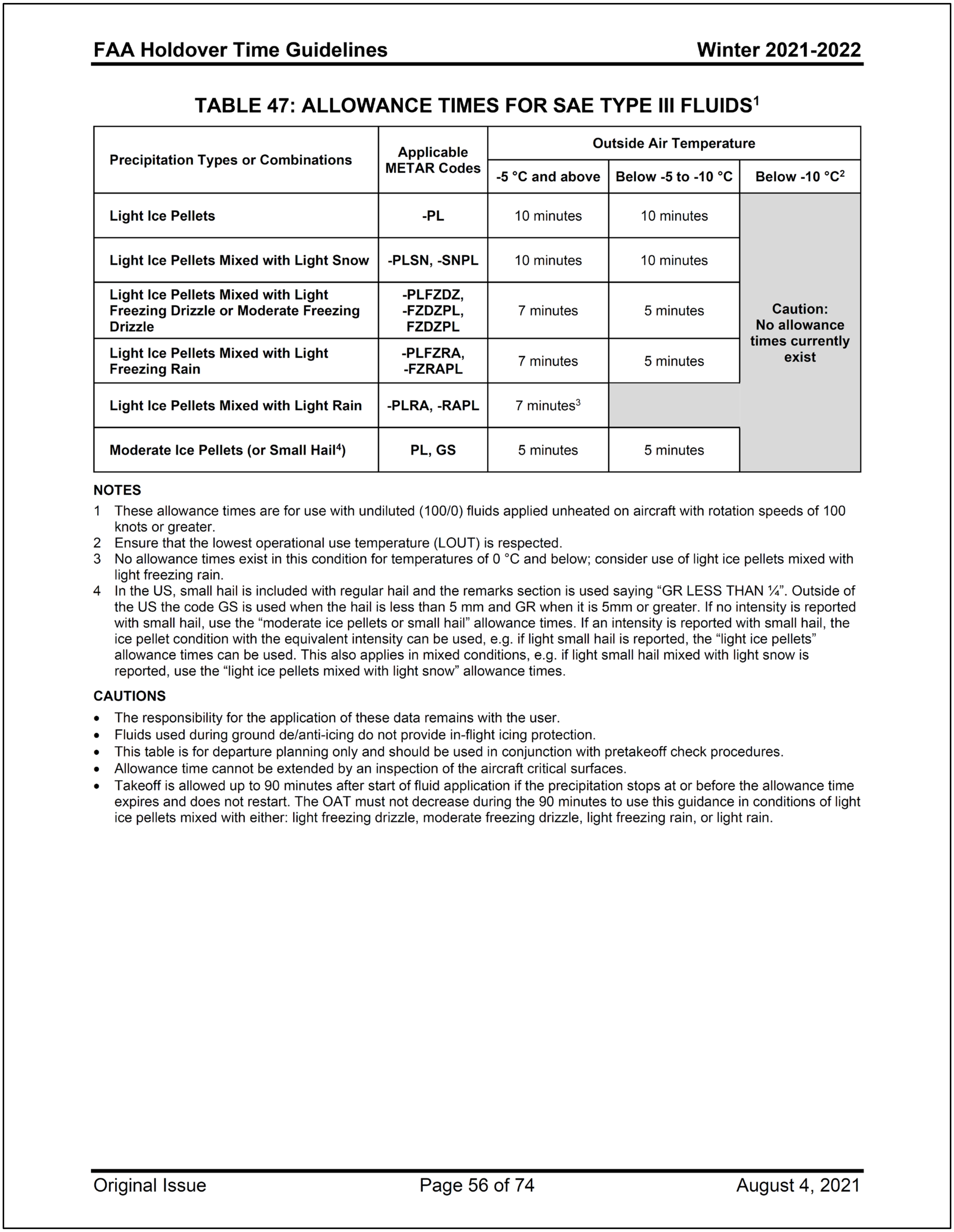
Table 8.2: 2021-22 FAA Type III Ice Pellet Allowance Time Table



FAA Holdover Time Guidelines **Winter 2021-2022**

TABLE 47: ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature		
		-5 °C and above	Below -5 to -10 °C	Below -10 °C[2]
Light Ice Pellets	-PL	10 minutes	10 minutes	Caution: No allowance times currently exist
Light Ice Pellets Mixed with Light Snow	-PLSN, -SNPL	10 minutes	10 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	-PLFZDZ, -FZDZPL, FZDZPL	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Freezing Rain	-PLFZRA, -FZRAPL	7 minutes	5 minutes	
Light Ice Pellets Mixed with Light Rain	-PLRA, -RAPL	7 minutes[3]		
Moderate Ice Pellets (or Small Hail[4])	PL, GS	5 minutes	5 minutes	

NOTES

1 These allowance times are for use with undiluted (100/0) fluids applied unheated on aircraft with rotation speeds of 100 knots or greater.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.
4 In the US, small hail is included with regular hail and the remarks section is used saying “GR LESS THAN ¼”. Outside of the US the code GS is used when the hail is less than 5 mm and GR when it is 5mm or greater. If no intensity is reported with small hail, use the “moderate ice pellets or small hail” allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the “light ice pellets” allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the “light ice pellets mixed with light snow” allowance times.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

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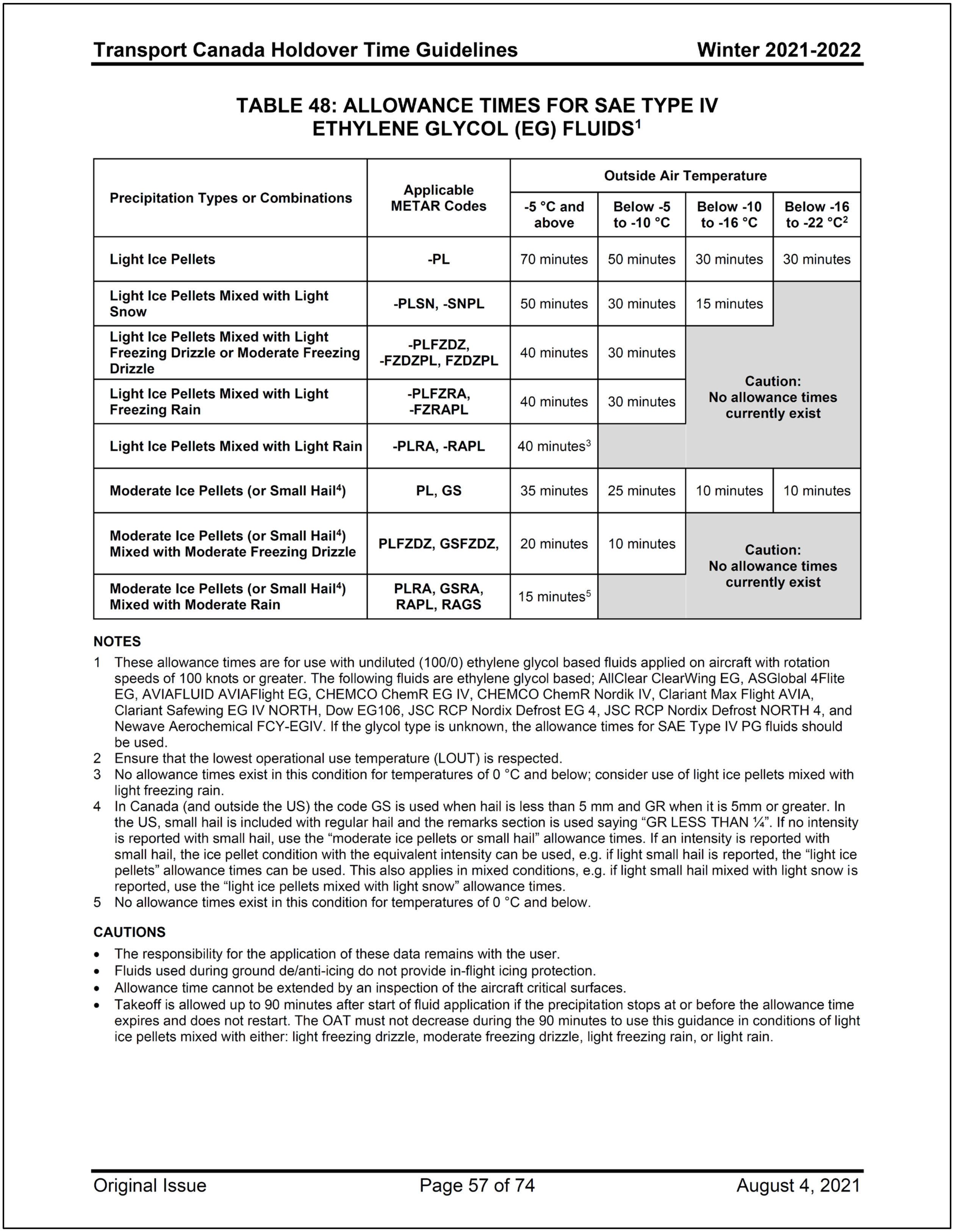
Table 8.3: 2021-22 TC Type IV EG Ice Pellet Allowance Time Table



Transport Canada Holdover Time Guidelines **Winter 2021-2022**

TABLE 48: ALLOWANCE TIMES FOR SAE TYPE IV ETHYLENE GLYCOL (EG) FLUIDS[1]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and above	Below -5 to -10 °C	Below -10 to -16 °C	Below -16 to -22 °C[2]
Light Ice Pellets	**-PL**	70 minutes	50 minutes	30 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	50 minutes	30 minutes	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	**-PLFZDZ, -FZDZPL, FZDZPL**	40 minutes	30 minutes	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Light Freezing Rain	**-PLFZRA, -FZRAPL**	40 minutes	30 minutes		
Light Ice Pellets Mixed with Light Rain	**-PLRA, -RAPL**	40 minutes[3]			
Moderate Ice Pellets (or Small Hail[4])	**PL, GS**	35 minutes	25 minutes	10 minutes	10 minutes
Moderate Ice Pellets (or Small Hail[4]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ,**	20 minutes	10 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[4]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	15 minutes[5]			

NOTES

1 These allowance times are for use with undiluted (100/0) ethylene glycol based fluids applied on aircraft with rotation speeds of 100 knots or greater. The following fluids are ethylene glycol based; AllClear ClearWing EG, ASGlobal 4Flite EG, AVIAFLUID AVIAFlight EG, CHEMCO ChemR EG IV, CHEMCO ChemR Nordik IV, Clariant Max Flight AVIA, Clariant Safewing EG IV NORTH, Dow EG106, JSC RCP Nordix Defrost EG 4, JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical FCY-EGIV. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.
4 In Canada (and outside the US) the code GS is used when hail is less than 5 mm and GR when it is 5mm or greater. In the US, small hail is included with regular hail and the remarks section is used saying "GR LESS THAN ¼". If no intensity is reported with small hail, use the "moderate ice pellets or small hail" allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the "light ice pellets" allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the "light ice pellets mixed with light snow" allowance times.
5 No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

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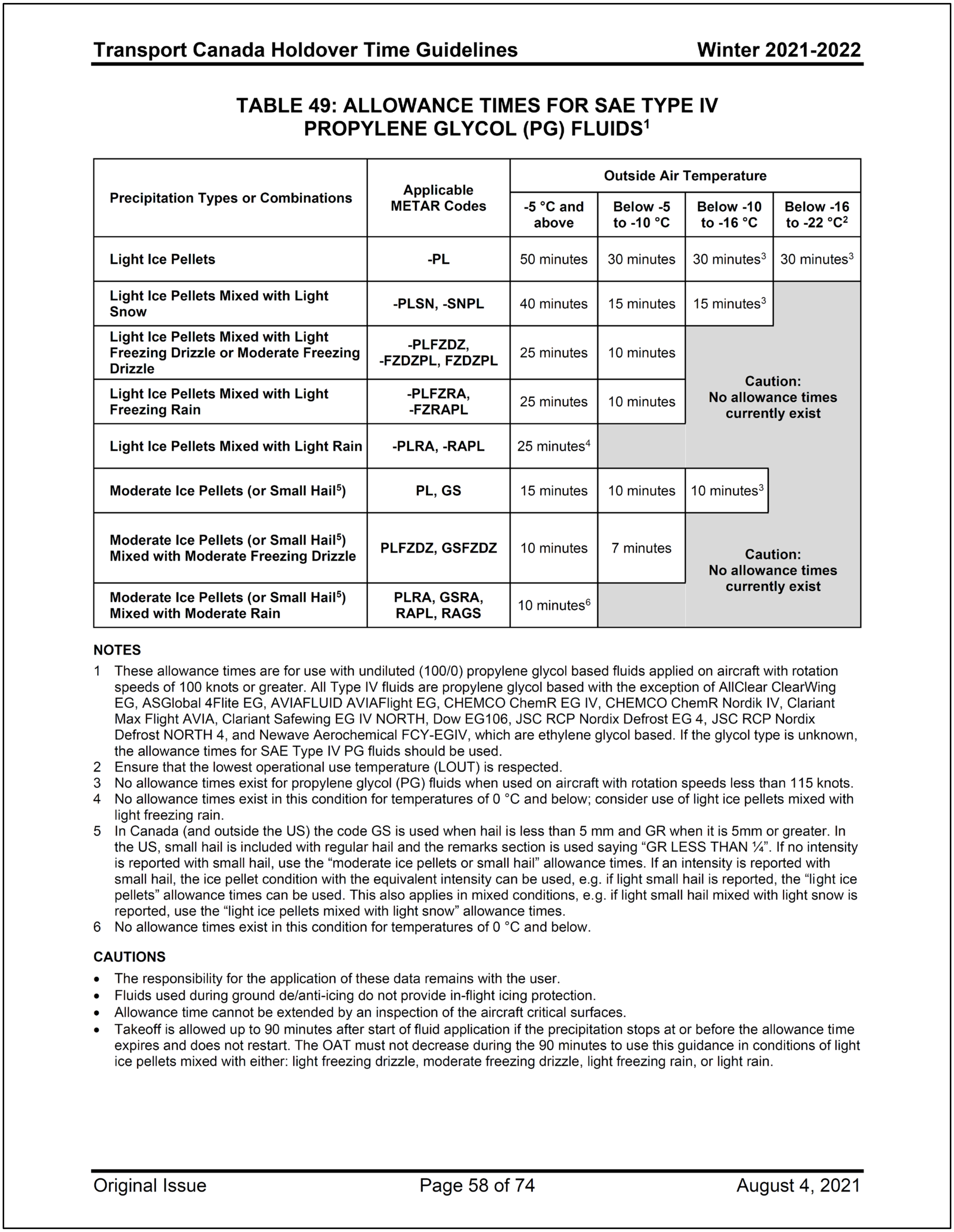
Table 8.4: 2021-22 TC Type IV PG Ice Pellet Allowance Time Table



Transport Canada Holdover Time Guidelines **Winter 2021-2022**

TABLE 49: ALLOWANCE TIMES FOR SAE TYPE IV PROPYLENE GLYCOL (PG) FLUIDS[1]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and above	Below -5 to -10 °C	Below -10 to -16 °C	Below -16 to -22 °C[2]
Light Ice Pellets	**-PL**	50 minutes	30 minutes	30 minutes[3]	30 minutes[3]
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	40 minutes	15 minutes	15 minutes[3]	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	**-PLFZDZ, -FZDZPL, FZDZPL**	25 minutes	10 minutes	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Light Freezing Rain	**-PLFZRA, -FZRAPL**	25 minutes	10 minutes		
Light Ice Pellets Mixed with Light Rain	**-PLRA, -RAPL**	25 minutes[4]			
Moderate Ice Pellets (or Small Hail[5])	**PL, GS**	15 minutes	10 minutes	10 minutes[3]	
Moderate Ice Pellets (or Small Hail[5]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ**	10 minutes	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[5]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	10 minutes[6]			

NOTES

1 These allowance times are for use with undiluted (100/0) propylene glycol based fluids applied on aircraft with rotation speeds of 100 knots or greater. All Type IV fluids are propylene glycol based with the exception of AllClear ClearWing EG, ASGlobal 4Flite EG, AVIAFLUID AVIAFlight EG, CHEMCO ChemR EG IV, CHEMCO ChemR Nordik IV, Clariant Max Flight AVIA, Clariant Safewing EG IV NORTH, Dow EG106, JSC RCP Nordix Defrost EG 4, JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical FCY-EGIV, which are ethylene glycol based. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 No allowance times exist for propylene glycol (PG) fluids when used on aircraft with rotation speeds less than 115 knots.
4 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.
5 In Canada (and outside the US) the code GS is used when hail is less than 5 mm and GR when it is 5mm or greater. In the US, small hail is included with regular hail and the remarks section is used saying "GR LESS THAN ¼". If no intensity is reported with small hail, use the "moderate ice pellets or small hail" allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the "light ice pellets" allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the "light ice pellets mixed with light snow" allowance times.
6 No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

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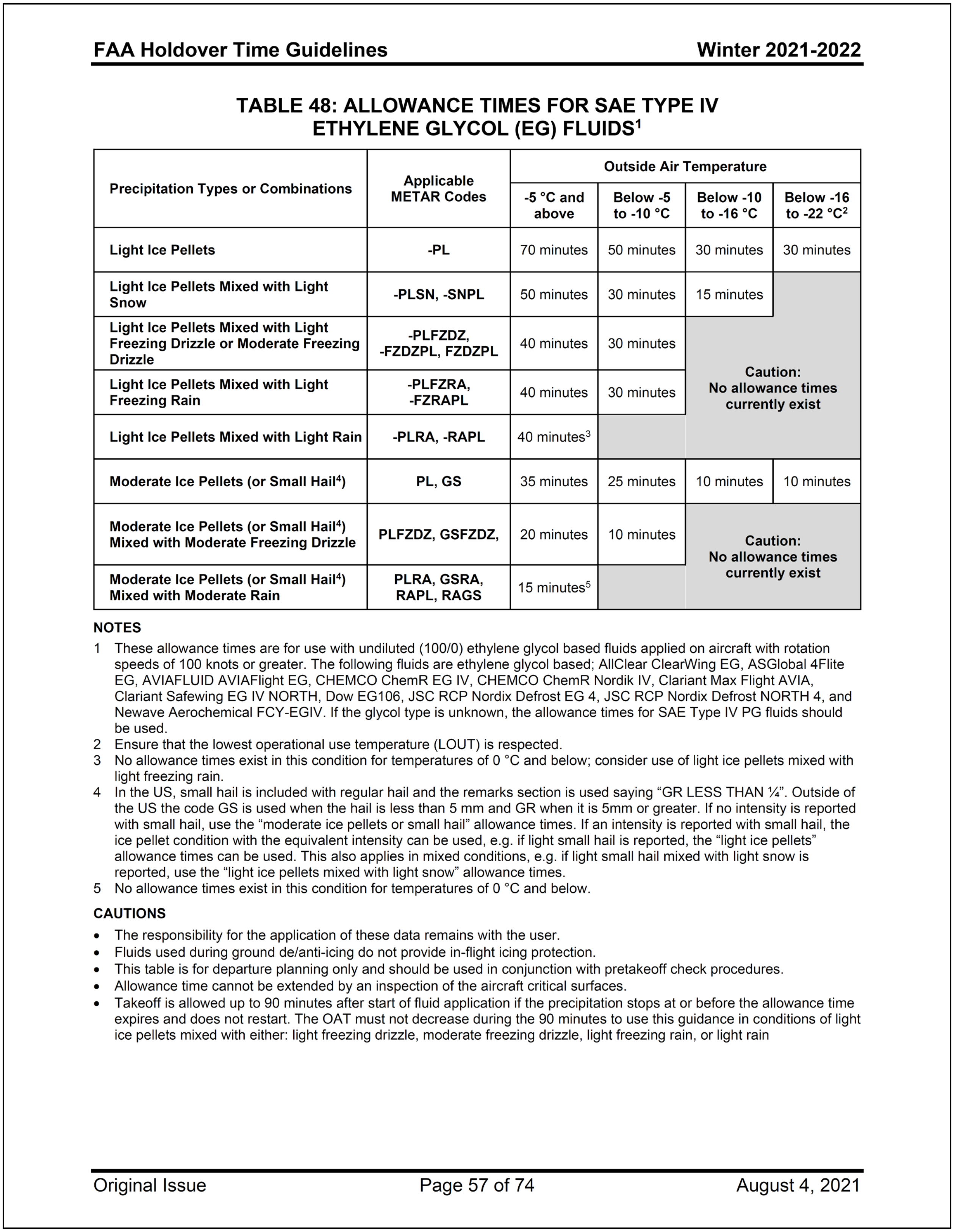
Table 8.5: 2021-22 FAA Type IV EG Ice Pellet Allowance Time Table



FAA Holdover Time Guidelines **Winter 2021-2022**

TABLE 48: ALLOWANCE TIMES FOR SAE TYPE IV ETHYLENE GLYCOL (EG) FLUIDS[1]

Precipitation Types or Combinations	**Applicable METAR Codes**	**Outside Air Temperature**			
		-5 °C and above	**Below -5 to -10 °C**	**Below -10 to -16 °C**	**Below -16 to -22 °C[2]**
Light Ice Pellets	**-PL**	70 minutes	50 minutes	30 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	50 minutes	30 minutes	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	**-PLFZDZ, -FZDZPL, FZDZPL**	40 minutes	30 minutes	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Light Freezing Rain	**-PLFZRA, -FZRAPL**	40 minutes	30 minutes		
Light Ice Pellets Mixed with Light Rain	**-PLRA, -RAPL**	40 minutes[3]			
Moderate Ice Pellets (or Small Hail[4])	**PL, GS**	35 minutes	25 minutes	10 minutes	10 minutes
Moderate Ice Pellets (or Small Hail[4]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ,**	20 minutes	10 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[4]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	15 minutes[5]			

NOTES

1 These allowance times are for use with undiluted (100/0) ethylene glycol based fluids applied on aircraft with rotation speeds of 100 knots or greater. The following fluids are ethylene glycol based; AllClear ClearWing EG, ASGlobal 4Flite EG, AVIAFLUID AVIAFlight EG, CHEMCO ChemR EG IV, CHEMCO ChemR Nordik IV, Clariant Max Flight AVIA, Clariant Safewing EG IV NORTH, Dow EG106, JSC RCP Nordix Defrost EG 4, JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical FCY-EGIV. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.

2 Ensure that the lowest operational use temperature (LOUT) is respected.

3 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.

4 In the US, small hail is included with regular hail and the remarks section is used saying “GR LESS THAN ¼”. Outside of the US the code GS is used when the hail is less than 5 mm and GR when it is 5mm or greater. If no intensity is reported with small hail, use the “moderate ice pellets or small hail” allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the “light ice pellets” allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the “light ice pellets mixed with light snow” allowance times.

5 No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain

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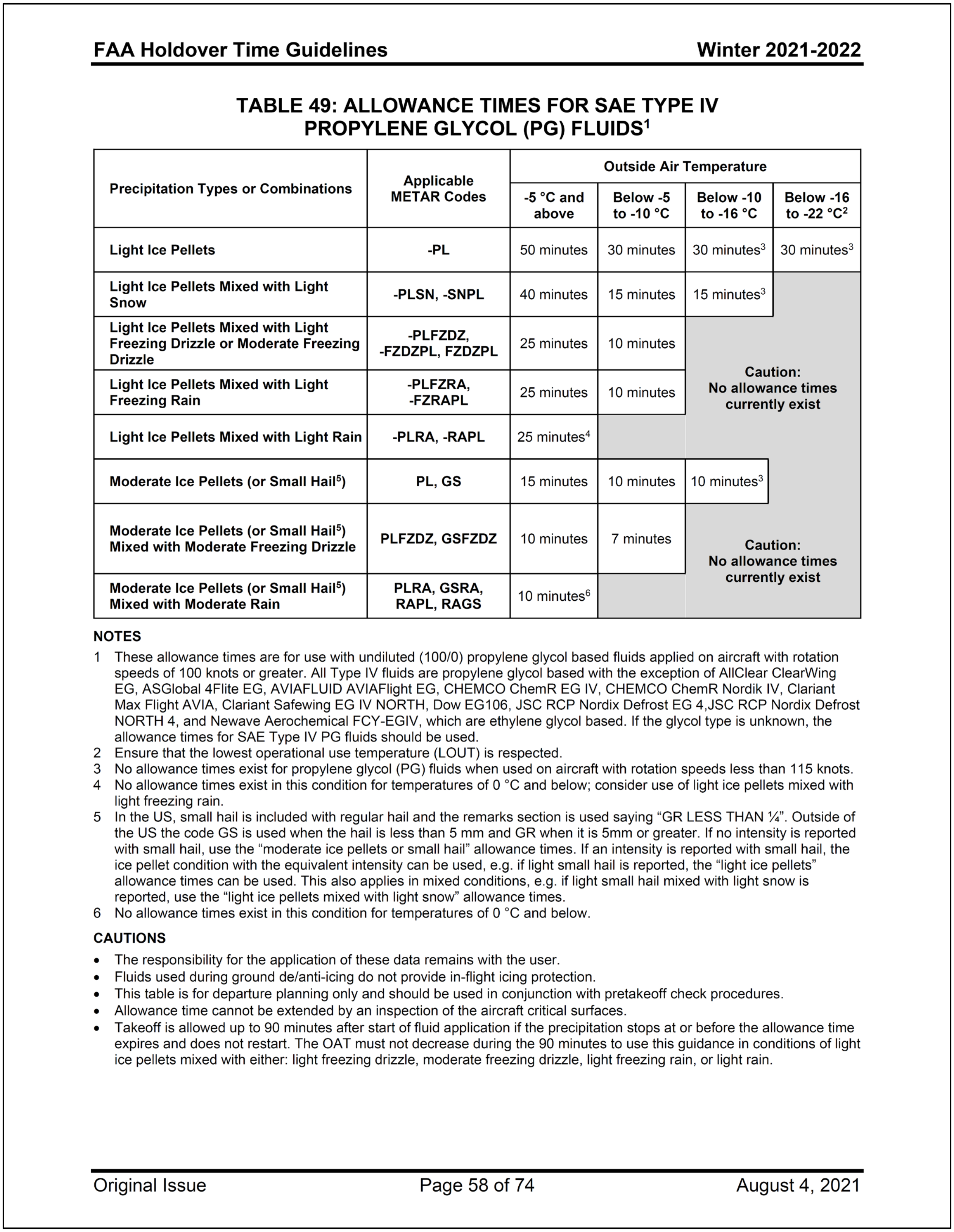
Table 8.6: 2021-22 FAA Type IV PG Ice Pellet Allowance Time Table



FAA Holdover Time Guidelines **Winter 2021-2022**

TABLE 49: ALLOWANCE TIMES FOR SAE TYPE IV PROPYLENE GLYCOL (PG) FLUIDS[1]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and above	Below -5 to -10 °C	Below -10 to -16 °C	Below -16 to -22 °C[2]
Light Ice Pellets	**-PL**	50 minutes	30 minutes	30 minutes[3]	30 minutes[3]
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	40 minutes	15 minutes	15 minutes[3]	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	**-PLFZDZ, -FZDZPL, FZDZPL**	25 minutes	10 minutes	**Caution: No allowance times currently exist**	
Light Ice Pellets Mixed with Light Freezing Rain	**-PLFZRA, -FZRAPL**	25 minutes	10 minutes		
Light Ice Pellets Mixed with Light Rain	**-PLRA, -RAPL**	25 minutes[4]			
Moderate Ice Pellets (or Small Hail[5])	**PL, GS**	15 minutes	10 minutes	10 minutes[3]	
Moderate Ice Pellets (or Small Hail[5]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ**	10 minutes	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[5]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	10 minutes[6]			

NOTES

1 These allowance times are for use with undiluted (100/0) propylene glycol based fluids applied on aircraft with rotation speeds of 100 knots or greater. All Type IV fluids are propylene glycol based with the exception of AllClear ClearWing EG, ASGlobal 4Flite EG, AVIAFLUID AVIAFlight EG, CHEMCO ChemR EG IV, CHEMCO ChemR Nordik IV, Clariant Max Flight AVIA, Clariant Safewing EG IV NORTH, Dow EG106, JSC RCP Nordix Defrost EG 4,JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical FCY-EGIV, which are ethylene glycol based. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 No allowance times exist for propylene glycol (PG) fluids when used on aircraft with rotation speeds less than 115 knots.
4 No allowance times exist in this condition for temperatures of 0 °C and below; consider use of light ice pellets mixed with light freezing rain.
5 In the US, small hail is included with regular hail and the remarks section is used saying "GR LESS THAN ¼". Outside of the US the code GS is used when the hail is less than 5 mm and GR when it is 5mm or greater. If no intensity is reported with small hail, use the "moderate ice pellets or small hail" allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the "light ice pellets" allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with light snow is reported, use the "light ice pellets mixed with light snow" allowance times.
6 No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.
- Allowance time cannot be extended by an inspection of the aircraft critical surfaces.
- Takeoff is allowed up to 90 minutes after start of fluid application if the precipitation stops at or before the allowance time expires and does not restart. The OAT must not decrease during the 90 minutes to use this guidance in conditions of light ice pellets mixed with either: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

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8.2 Future Research

This section describes higher priority areas of possible future wind tunnel testing and research. These areas have been determined based on consultations with TC, the FAA, and NASA and on industry discussions, and as such they may not be directly linked to the research described in this report. These areas have been listed below for ease of reference and to maintain continuity in the year-to-year reporting.

8.2.1 Substantiation of Ice Pellet Allowance Times with New Fluids

Testing should continue to investigate different Type III and Type IV fluids to further substantiate the Ice Pellet Allowance Times. Testing should consider new fluids or fluids previously tested but with limited data.

As a priority, testing should continue with Cryotech Polar Guard Xtend to address the limited data collected during the winter of 2020-21.

8.2.2 Allowance Time Expansion

The recent EG expansion work has indicated that there is still potential to expand the allowance times for EG fluids below -10ºC; however, additional data is required to support the preliminary data collected to date. Additional testing is recommended before implementing these changes to the guidelines.

In addition, historical testing has shown that the allowance times for Type IV and especially Type III fluids are conservative and have room for expansion. Testing should be conducted to obtain longer times and to include additional conditions for both Type III and Type IV fluids.

8.2.3 Research with a Common Research Model Vertical Stabilizer

Previous de/anti-icing fluid research with a Piper Seneca II vertical stabilizer model provided useful data and observations to the industry. A new common research model is being developed to be a generic, more appropriate, and representative model for testing. Once fabricated, testing should be conducted to study de/anti-icing fluid flow-off properties with and without contamination.

8.2.4 Testing with the NASA LS-0417 Wing Section to Support Development of Type III Mid-Speed Allowance Times

The extensive work conducted with the thin high-performance wing section has led to the development of a methodology for evaluating aerodynamic performance based on a lift loss scaling between the model results and the AS5900 aerodynamic acceptance test. It is recommended that the same methodology be used to develop a lift loss correlation for the LS-0417 wing section, which is better suited for the development of mid-speed Type III allowance times. This methodology is now feasible as the AS5900 standard has been updated to include a new mid-speed ramp which is better suited for these types of tests. Once a correlation has been developed, the Type III high-speed allowance times should be validated using the LS-0417 wing section and mid-speed ramp. Heated fluid tests should also be considered.

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REFERENCES

1. Ruggi, M., *Wind Tunnel Trials to Examine Anti-Icing Fluid Flow-Off Characteristics and to Support the Development of Ice Pellet Allowance Times, Winters 2009-10 to 2012-13,* APS Aviation Inc., Transportation Development Centre, Montreal, November 2013, TP 15232E, 1044.

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APPENDIX A

TRANSPORT CANADA
STATEMENT OF WORK EXCERPT –
AIRCRAFT & ANTI-ICING FLUID WINTER TESTING 2020-21

TRANSPORT CANADA
STATEMENT OF WORK EXCERPT –
AIRCRAFT & ANTI-ICING FLUID WINTER TESTING 2020-21

10. Wind Tunnel Testing – Planning and Setup Activities Only

Note: The NRC facility costs associated with manufacturing the test model and testing at M-46 are not included in this task and are dealt directly with TC through a M.O.U. agreement with NRC.

This budget associated with this project is only associated to tasks a) and b). Tasks c), d), e), and f) are budgeted as part of a separate project.

a) Coordinate with staff of NRC M-46 for scheduling and to organize any modifications to the wind tunnel, model, or related equipment. Review fluid requirements and request fluid samples from fluid manufacturers.

b) Develop a procedure and test plan and coordinate with the NRC staff that operates the PIWT.

~~c) Perform pre-testing activities including the preparation of equipment, purchasing of equipment, training of personnel, and transportation and setup of equipment.~~

~~d) Perform wind tunnel tests (5 days) with the RJ or LS-0417 wing to support the development of ice pellet allowance times. Testing objectives can include:~~

~~i. Validation of the existing Type IV fluid allowance times for use with the newly certified anti-icing fluids, or with fluids for which data is lacking;~~

~~ii. Development of an EG-specific allowance time table to be able to benefit from potentially longer times; and~~

~~iii. Expansion of the allowance for Type III fluids at low speeds to get longer times and guidance in more conditions.~~

~~It is anticipated that testing will be conducted during overnight hours over a period of two weeks. The typical procedure is described as follows, but may be modified to address specific testing objectives. Prior to starting each test event, correlation testing is required to calibrate the TC model and to demonstrate repeatability. Wind tunnel tests will be performed with ethylene glycol and propylene glycol anti-icing fluids at below freezing temperatures; Type I deicing fluids may also be considered. Tests will simulate low speed or high speed takeoffs and will look at simulating different cross wind conditions, rudder angles, and asymmetric contamination. During contaminated test runs, a baseline fluid only case may be run immediately before, or after the contaminated test run to provide a direct correlation of the results. High~~

~~resolution photos will be taken of the fluid motion at the leading and trailing edges of the vertical stabilizer at a rate of about 3 frames per second, with lighting adequate to see the fluid waves and ripples of about 1mm in height. Observers will document the appearance of fluid on the vertical stabilizer during the simulated takeoff run and climb of the aircraft by analyzing the photographic records. The testing team will collect, among other things, the following data during the tests: type and amount of fluid applied, type and rate of contamination applied, and extent of fluid contamination prior to the test run.~~

~~e) Analyze data.~~

~~Report the findings and prepare presentation material for the SAE G-12 meeting.~~

11. Wind Tunnel Testing – Week 1 Activities TBD (5 Days)

Note: The NRC facility costs associated with manufacturing the test model and testing at M-46 are not included in this task and are dealt directly with TC through a M.O.U. agreement with NRC.

This budget associated with this project is only associated to tasks c), d), e), and f) and includes 5 days of testing. Tasks a) and b) are budgeted as part of a separate project.

~~a) Coordinate with staff of NRC M-46 for scheduling and to organize any modifications to the wind tunnel, model, or related equipment. Review fluid requirements and request fluid samples from fluid manufacturers.~~

~~b) Develop a procedure and test plan and coordinate with the NRC staff that operates the PIWT.~~

c) Perform pre-testing activities including the preparation of equipment, purchasing of equipment, training of personnel, and transportation and setup of equipment.

d) Perform wind tunnel tests (5 days) with the RJ or LS-0417 wing to support the development of ice pellet allowance times. Testing objectives can include:

  i. Validation of the existing Type IV fluid allowance times for use with the newly certified anti-icing fluids, or with fluids for which data is lacking;

  ii. Development of an EG-specific allowance time table to be able to benefit from potentially longer times; and

  iii. Expansion of the allowance for Type III fluids at low speeds to get longer times and guidance in more conditions.

It is anticipated that testing will be conducted during overnight hours over a period of one week. The typical procedure is described as follows, but may be modified to address specific testing objectives. Prior to starting each test event, correlation testing is required to calibrate the TC model and to demonstrate repeatability. Wind tunnel tests will be performed with ethylene glycol and propylene glycol anti-icing fluids at below freezing temperatures; Type I deicing fluids may also be considered. Tests will simulate low speed or high-speed takeoffs and will look at simulating different cross wind conditions, rudder angles, and asymmetric contamination. During contaminated test runs, a baseline fluid only case may be run immediately before, or after the contaminated test run to provide a direct correlation of the results. High resolution photos will be taken of the fluid motion at the leading and trailing edges of the vertical stabilizer at a rate of about 3 frames per second, with lighting adequate to see the fluid waves and ripples of about 1mm in height. Observers will document the appearance of fluid on the vertical stabilizer during the simulated takeoff run and climb of the aircraft by analyzing the photographic records. The testing team will collect, among other things, the following data during the tests: type and amount of fluid applied, type and rate of contamination applied, and extent of fluid contamination prior to the test run.

e) Analyze data.

f) Report the findings and prepare presentation material for the SAE G-12 meeting.

12. Wind Tunnel Testing – Week 2 Activities TBD (Additional 5 Days)

Note: The NRC facility costs associated with manufacturing the test model and testing at M-46 are not included in this task and are dealt directly with TC through a M.O.U. agreement with NRC.

This budget associated with this project is only associated to tasks d) and includes an additional 5 days of testing. Tasks a), b), c), e), f) are budgeted as part of separate projects.

~~a) Coordinate with staff of NRC M-46 for scheduling and to organize any modifications to the wind tunnel, model, or related equipment. Review fluid requirements and request fluid samples from fluid manufacturers.~~

~~b) Develop a procedure and test plan and coordinate with the NRC staff that operates the PIWT.~~

~~c) Perform pre-testing activities including the preparation of equipment, purchasing of equipment, training of personnel, and transportation and setup of equipment.~~

d) Perform wind tunnel tests (5 days) with the RJ or LS-0417 wing to support the development of ice pellet allowance times. Testing objectives can include:

   i. Validation of the existing Type IV fluid allowance times for use with the newly certified anti-icing fluids, or with fluids for which data is lacking;

   ii. Development of an EG-specific allowance time table to be able to benefit from potentially longer times; and

   iii. Expansion of the allowance for Type III fluids at low speeds to get longer times and guidance in more conditions.

   It is anticipated that testing will be conducted during overnight hours over a period of one week. The typical procedure is described as follows, but may be modified to address specific testing objectives. Prior to starting each test event, correlation testing is required to calibrate the TC model and to demonstrate repeatability. Wind tunnel tests will be performed with ethylene glycol and propylene glycol anti-icing fluids at below freezing temperatures; Type I deicing fluids may also be considered. Tests will simulate low speed or high-speed takeoffs and will look at simulating different cross wind conditions, rudder angles, and asymmetric contamination. During contaminated test runs, a baseline fluid only case may be run immediately before, or after the contaminated test run to provide a direct correlation of the results. High resolution photos will be taken of the fluid motion at the leading and trailing edges of the vertical stabilizer at a rate of about 3 frames per second, with lighting adequate to see the fluid waves and ripples of about 1mm in height. Observers will document the appearance of fluid on the vertical stabilizer during the simulated takeoff run and climb of the aircraft by analyzing the photographic records. The testing team will collect, among other things, the following data during the tests: type and amount of fluid applied, type and rate of contamination applied, and extent of fluid contamination prior to the test run.

~~e) Analyze data.~~

~~f) Report the findings and prepare presentation material for the SAE G-12 meeting.~~

13. Wind Tunnel Testing – Week 3 Activities TBD (Additional 5 Days)

Note: The NRC facility costs associated with manufacturing the test model and testing at M-46 are not included in this task and are dealt directly with TC through a M.O.U. agreement with NRC.

This budget associated with this project is only associated to tasks d) and includes an additional 5 days of testing. Tasks a), b), c), e), f) are budgeted as part of separate projects.

a) ~~Coordinate with staff of NRC M-46 for scheduling and to organize any modifications to the wind tunnel, model, or related equipment. Review fluid requirements and request fluid samples from fluid manufacturers.~~

b) ~~Develop a procedure and test plan and coordinate with the NRC staff that operates the PIWT.~~

c) ~~Perform pre-testing activities including the preparation of equipment, purchasing of equipment, training of personnel, and transportation and setup of equipment.~~

d) Perform wind tunnel tests (5 days) with the RJ or LS-0417 wing to support the development of ice pellet allowance times. Testing objectives can include:

   i. Validation of the existing Type IV fluid allowance times for use with the newly certified anti-icing fluids, or with fluids for which data is lacking;

   ii. Development of an EG-specific allowance time table to be able to benefit from potentially longer times; and

   iii. Expansion of the allowance for Type III fluids at low speeds to get longer times and guidance in more conditions.

   It is anticipated that testing will be conducted during overnight hours over a period of one week. The typical procedure is described as follows, but may be modified to address specific testing objectives. Prior to starting each test event, correlation testing is required to calibrate the TC model and to demonstrate repeatability. Wind tunnel tests will be performed with ethylene glycol and propylene glycol anti-icing fluids at below freezing temperatures; Type I deicing fluids may also be considered. Tests will simulate low speed or high speed takeoffs and will look at simulating different cross wind conditions, rudder angles, and asymmetric contamination. During contaminated test runs, a baseline fluid only case may be run immediately before, or after the contaminated test run to provide a direct correlation of the results. High resolution photos will be taken of the fluid motion at the leading and trailing edges of the vertical stabilizer at a rate of about 3 frames per second, with lighting adequate to see the fluid waves and ripples of about 1mm in height. Observers will document the appearance of fluid on the vertical stabilizer during the simulated takeoff run and climb of the aircraft by analyzing the photographic records. The testing team will collect, among other things, the following data during the tests: type and amount of fluid applied, type and rate of contamination applied, and extent of fluid contamination prior to the test run.

e) ~~Analyze data.~~

f) ~~Report the findings and prepare presentation material for the SAE G-12 meeting.~~

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APPENDIX B

PROCEDURE: WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS
WINTER 2020-21

300293

PROCEDURE:

WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Winter 2020-21

Prepared for:

Transport Canada
Innovation Centre

In cooperation with:

Federal Aviation Administration
William J. Hughes Technical Center

Transport Canada
Civil Aviation

Federal Aviation Administration
Flight Standards – Air Carrier Operations

Prepared by: Marco Ruggi

Reviewed by: John D'Avirro

December 21, 2020
Final Version 1.0

WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Winter 2020-21

1. BACKGROUND

In 2005-06, the inability of operators to release aircraft in ice pellet conditions led Transport Canada (TC) and the Federal Aviation Administration (FAA) to begin a research campaign to develop allowance times for these conditions. Developing holdover times (HOTs) was not feasible due to the properties of the ice pellets; they remain embedded in the fluid and take long to dissolve as compared to snow which is immediately absorbed and dissolved. Research was initiated by live aircraft testing with the National Research Council Canada (NRC) Falcon 20 in Ottawa Ontario, and later evolved to testing in a more controlled environment with the NRC Propulsion Icing Wind Tunnel (PIWT) also in Ottawa Ontario.

Early testing in 2005-06 with the Falcon 20 primarily used visual observations to evaluate fluid flow-off. During the Falcon 20 work the wing was anti-iced, exposed to contamination, and aborted takeoff runs were performed allowing researchers on-board to observe and evaluate the fluid flow-off. Testing in 2006-07 began in the PIWT allowing aerodynamic data to be used for evaluating fluid flow-off performance. The PIWT also allowed for a more controlled environment less susceptible to the elements.

The work continued each year, and the test methods and equipment improved allowing for real-time data analysis, better repeatability, and overall greater confidence in the results. The work conducted by TC/FAA was presented by APS Aviation Inc. (APS) to the SAE International (SAE) G-12 Aerodynamic Working Group (AWG) and HOT Committee yearly since 2006. Additional presentations were also given at the AWG in May 2012 and May 2013 by the National Aeronautics and Space Administration (NASA) and the NRC, which focused on the extensive calibration and characterization work performed with a generic thin high performance airfoil. This work also helped increase confidence in how the data were used to help support TC/FAA rule-making. A detailed account of the more recent work conducted is included in the TC report, TP 15232E*, Wind Tunnel Trials to Examine Anti-Icing Fluid Flow-Off Characteristics and to Support the Development of Ice Pellet Allowance Times, Winters 2009-10 to 2012-13*.

The Ice Pellet Allowance Time research has helped further develop and improve the PIWT facility. As a result, a new medium is now available for aerodynamic testing of aircraft ground icing fluids with or without contamination in a full-scale format. Several other ground deicing projects have been ongoing as a result of industry requests and are expected to continue. The PIWT has evolved into a multidisciplinary facility; however, it continues to be the primary source for the development and further refinement of the ground deicing ice pellet allowance time guidance material. Research at the PIWT with and without ice pellets has continued on a yearly or bi-yearly basis and is performed by APS, with support of the NRC, on behalf of TC/FAA.

For the Winter 2020-21, testing will continue the development of ice pellet allowance times.

2. OBJECTIVES AND TIMING

The following describes the objectives and timing of the research. Fifteen days of testing are being planned based on TC/FAA funding resources, all of which are reserved for testing with the RJ wing model.

2.1 Type IV Allowance Time Validation Testing

The objective of this testing is to conduct aerodynamic testing with a thin high performance airfoil to:

- Substantiate the current Type IV ice pellet allowance times with new fluids and at temperatures close to the lowest operational use temperature (LOUT).

To satisfy this objective, a thin high performance wing section (Figure 2.1) will be subjected to a series of tests in the NRC PIWT. The dimensions indicated are in inches. This wing section was constructed by NRC in 2009 specifically for the conduct of these tests following extensive consultations with an airframe manufacturer to ensure a representative thin high performance design.

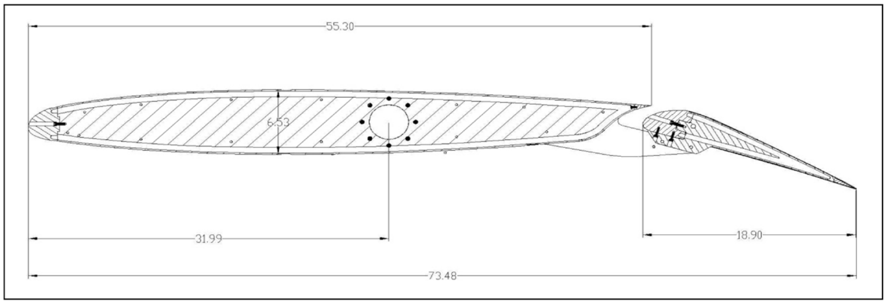


Figure 2.1: Thin High Performance Wing Section

Approximately four days of testing are required for the conduct of these tests.

2.2 Type IV Allowance Time Expansion for Ethylene Glycol Fluids

The objective of this testing is to conduct aerodynamic testing with a thin high performance airfoil to:

- Expand the current Type IV ice pellet allowance times for ethylene glycol (EG) fluids.

To satisfy this objective, a thin high performance wing section (described in Subsection 2.1 and shown in Figure 2.1) will be subjected to a series of tests in the NRC PIWT.

Approximately ten days of testing are required for the conduct of these tests.

2.3 Timing

Approximately four days are required for the "Type IV Allowance Time Validation Testing" (Subsection 2.1), and approximately ten days are required for the "Type IV Allowance Time Expansion for EG Fluids" (Subsection 2.2). An additional day will be required for setup, teardown, and calibration related activities. This totals the fifteen days of testing based on the available TC/FAA funding resources.

Fluid viscosity sampling and testing will be conducted as soon as all fluids are received at the NRC IWT. The equipment will be prepped and packed the latest by January 6th. On January 7th, the team will travel to the NRC IWT to drop off and setup most of the equipment. January 8th will be slated for ice pellet and snow manufacturing in advance of the testing (YOWs alone). The first two hours or more of the first day of testing will be dedicated to completing the setup, and as required, the calibration of the rain sprayer and ice pellet and snow dispensers.

At the time of writing this procedure, it is expected that testing with the RJ wing model will start on January 10th, 2021. Testing will likely be conducted during overnight periods (i.e., 9 pm – 5 am), unless temperatures are suitable for day/evening testing. The weekends will be considered only if deemed necessary. Details of the schedule are included in Table 2.1.

Table 2.1: Test Calendar

JANUARY 2021						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Jan 3	4	5	6 *Pack up truck in YUL at APS Site*	7 *Leave YUL for YOW NRC IWT for Preliminary Setup*	8 *Ice Pellet and Snow Manufacturing at NRC IWT*	9
Jan 10 ***TEST DAY 1*** *Setup, Calibration, and Teardown*	11 ***TEST DAY 2*** RJ WING IP Validation New Fluids	12 ***TEST DAY 3*** RJ WING IP Validation New Fluids	13 ***TEST DAY 4*** RJ WING IP Validation New Fluids	14 ***TEST DAY 5*** RJ WING IP Validation New Fluids	15	16
Jan 17 ***TEST DAY 6*** RJ WING IP EG Expansion	18 ***TEST DAY 7*** RJ WING IP EG Expansion	19 ***TEST DAY 8*** RJ WING IP EG Expansion	20 ***TEST DAY 9*** RJ WING IP EG Expansion	21 ***TEST DAY 10*** RJ WING IP EG Expansion	22	23
Jan 24 ***TEST DAY 11*** RJ WING IP EG Expansion	25 ***TEST DAY 12*** RJ WING IP EG Expansion	26 ***TEST DAY 13*** RJ WING IP EG Expansion	27 ***TEST DAY 14*** RJ WING IP EG Expansion	28 ***TEST DAY 15*** RJ WING IP EG Expansion	29	30
Jan 31 ***EXTRA DAY 16*** If required	Feb 1 ***EXTRA DAY 17*** If required	2 ***EXTRA DAY 18*** If required	3 ***EXTRA DAY 19*** If required	4 ***EXTRA DAY 20*** If required	5	6
Feb 7 ***EXTRA DAY 21*** If required	8 ***EXTRA DAY 22*** If required	9 ***EXTRA DAY 23*** If required	10 ***EXTRA DAY 24*** If required	11 ***EXTRA DAY 25*** If required	12	13

NOTES

Testing will be conducted during overnight periods (9:00 pm - 5:00 am) i.e. Sunday Test Day 1 has a 9:00pm start.

Anticipate 5 days per week testing, however, weekend may be considered due to temperature.

Testing team will be JD, MR, BB, CB, BG & YOW x 5

3. TEST PLAN

The NRC wind tunnel is an open circuit tunnel. The temperature inside the wind tunnel is dependent on the outside air temperature. Prior to testing, the weather should be monitored to ensure proper temperatures for testing.

Representative Type I/II/III/IV propylene and ethylene fluids in Neat form (standard mix or 10-degree buffer for Type I) shall be evaluated against their uncontaminated performance.

A preliminary list of test objectives is shown in Table 3.1 (only Priority 1 objectives will be attempted unless indicated otherwise by TC/FAA directive). It should be noted that the order in which the tests will be carried out will depend on weather conditions and TC/FAA directive. A detailed test matrix (subject to change) related to Item #1, #2, and #3 are shown in Table 3.2. As some of this testing is exploratory, changes to the test plan may be made at the time of testing and will be confirmed by TC/FAA.

NOTE: The numbering of the test runs will be done in a sequential order starting with number 1.

A rating system has been developed for fluid and contamination tests and will be filled out by the on-site experts when applicable. The overall rating will provide insight into the severity of the conditions observed. A test failure (failure to shed the fluid at time of rotation) shall be determined by the on-site experts based on residual contamination.

Table 3.1: Preliminary List of Testing Objectives for Winter 2020-21 Wind Tunnel Testing

Item #	Objective	Priority	Description	# of Days
0	Setup, Teardown, and Precipitation Calibration	1	Setup of equipment and calibration of the rain sprayer and the ice pellet and snow dispensers (to be done on the first day of testing)	1
1	Dry Wing Baseline Repeatability	1	Baseline test at beginning of each day to ensure repeatability (part of NRC shakedown tests so no days allotted)	N/A
2	Type IV IP AT Validation (New Fluids)	1	Substantiate current times with new fluids	4
3	Development of EG Specific IP Allowance Times	1	Support the development of an EG fluid specific ice pellet allowance time table to benefit of potential longer times	10
4	Other R&D Activities	2	Could be selected from item # 5.1 to 5.11	0
4.1	Type III Allowance Time Expansion	-	Expand the current Type III allowance times to have increased times, or more cells	-
4.2	Snow Allowance Times Using Aerodynamic Data	-	Investigate feasibility of developing snow allowance times using the same aerodynamic based methodology used for ice pellets	-
4.3	Heavy Snow	-	Continue Heavy Snow Research comparing lift losses with Light/Moderate Snow vs. Heavy Snow	-
4.4	Heavy Contamination (Aero vs. Visual Failure)	-	Continue work looking at aerodynamic failure vs. HOT defined failure, and effect of surface roughness on lift degradation	-
4.5	Fluid + Contamination @ LOUT	-	Effect of contamination on fluid performance at LOUT with IP, SN, ZF, Frost etc.	-
4.6	Simulate Frost in Wind Tunnel	-	Attempt to simulate frost conditions in wind tunnel.	-
4.7	130-150 Knots IP Testing	-	Conduct IP testing at 130-150 knots or validate feasibility MAY NEED TO MODIFY TUNNEL	-
4.8	2nd Wave of Fluid During Rotation	-	Investigate the aero effects of the 2nd wave of fluid created from fluid at the stagnation point which flows over the LE during rotation	-
4.9	V-Stab Testing		Document contaminated fluid flow-off on a vertical stabilizer. Includes calibration work and procedural development.	
4.10	Other	-	Any potential suggestions from industry	-

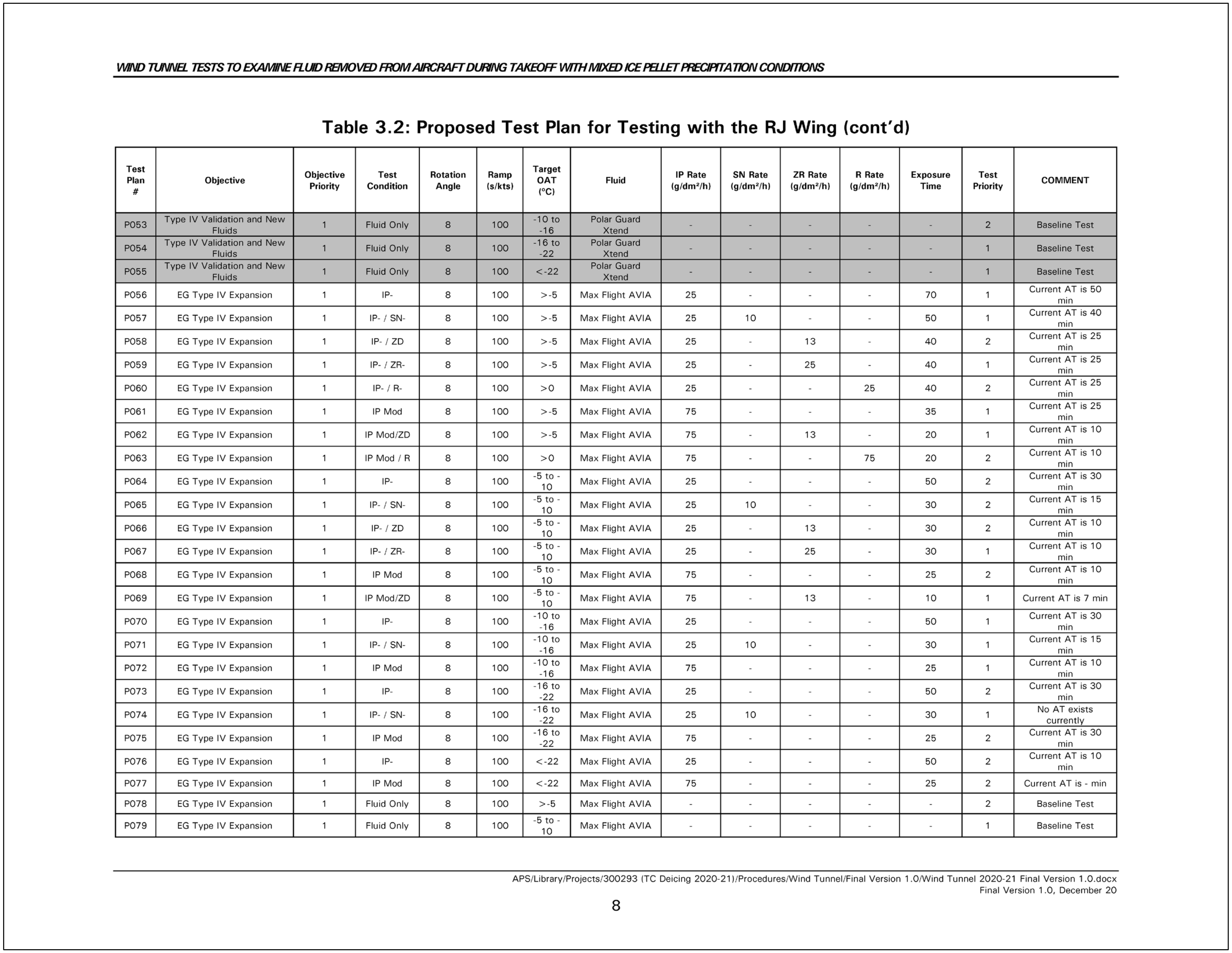
Total # of Days for Priority 1 Tests	**15**

Table 3.2: Proposed Test Plan for Testing with the RJ Wing

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time	Test Priority	COMMENT
P001	Baseline	1	Dry Wing	8	100	any	none	-	-	-	-	-	1	@start of day
P002	Baseline	1	Dry Wing	22	80	any	none	-	-	-	-	-	1	@start of day
P003	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	Max Flight SNEG	25	10	-	-	15	2	
P004	Type IV Validation and New Fluids	1	IP-	8	100	>-5	ClearWing EG	25	-	-	-	50	1	
P005	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	ClearWing EG	25	10	-	-	40	1	
P006	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	ClearWing EG	25	-	13	-	25	2	
P007	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	ClearWing EG	25	-	25	-	25	1	
P008	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	ClearWing EG	25	-	-	25	25	2	
P009	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	ClearWing EG	75	-	-	-	25	1	
P010	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	ClearWing EG	75	-	13	-	10	1	
P011	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	ClearWing EG	75	-	-	75	10	2	
P012	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	ClearWing EG	25	-	-	-	30	2	
P013	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	ClearWing EG	25	10	-	-	15	2	
P014	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	ClearWing EG	25	-	13	-	10	2	
P015	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	ClearWing EG	25	-	25	-	10	1	
P016	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	ClearWing EG	75	-	-	-	10	2	
P017	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	ClearWing EG	75	-	13	-	7	1	
P018	Type IV Validation and New Fluids	1	IP-	8	100	-10 to -16	ClearWing EG	25	-	-	-	30	1	
P019	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-10 to -16	ClearWing EG	25	10	-	-	15	1	
P020	Type IV Validation and New Fluids	1	IP Mod	8	100	-10 to -16	ClearWing EG	75	-	-	-	10	1	
P021	Type IV Validation and New Fluids	1	IP-	8	100	-16 to -22	ClearWing EG	25	-	-	-	30	2	
P022	Type IV Validation and New Fluids	1	IP Mod	8	100	-16 to -22	ClearWing EG	75	-	-	-	10	2	
P023	Type IV Validation and New Fluids	1	IP-	8	100	<-22	ClearWing EG	25	-	-	-	30	2	
P024	Type IV Validation and New Fluids	1	IP Mod	8	100	<-22	ClearWing EG	75	-	-	-	10	2	
P025	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	ClearWing EG	-	-	-	-	-	2	Baseline Test
P026	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	ClearWing EG	-	-	-	-	-	1	Baseline Test

Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time	Test Priority	COMMENT
P027	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	ClearWing EG	-	-	-	-	-	2	Baseline Test
P028	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P029	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P030	Type IV Validation and New Fluids	1	IP-	8	100	>-5	Polar Guard Xtend	25	-	-	-	50	1	
P031	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	Polar Guard Xtend	25	10	-	-	40	1	
P032	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	Polar Guard Xtend	25	-	13	-	25	2	
P033	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	Polar Guard Xtend	25	-	25	-	25	1	
P034	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	Polar Guard Xtend	25	-	-	25	25	2	
P035	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	Polar Guard Xtend	75	-	-	-	15	1	15 min for PG
P036	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	Polar Guard Xtend	75	-	13	-	10	1	
P037	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	Polar Guard Xtend	75	-	-	75	10	2	
P038	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	Polar Guard Xtend	25	-	-	-	30	2	
P039	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	Polar Guard Xtend	25	10	-	-	15	2	
P040	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	Polar Guard Xtend	25	-	13	-	10	2	
P041	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	Polar Guard Xtend	25	-	25	-	10	1	
P042	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	Polar Guard Xtend	75	-	-	-	10	2	
P043	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	Polar Guard Xtend	75	-	13	-	7	1	
P044	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	Polar Guard Xtend	25	-	-	-	30	1	115knts for PG
P045	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	Polar Guard Xtend	25	10	-	-	15	1	115knts for PG
P046	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	Polar Guard Xtend	75	-	-	-	10	1	115knts for PG
P047	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	Polar Guard Xtend	25	-	-	-	30	2	115knts for PG
P048	Type IV Validation and New Fluids	1	IP Mod	8	115	-16 to -22	Polar Guard Xtend	75	-	-	-	0	2	No Allowance Time
P049	Type IV Validation and New Fluids	1	IP-	8	115	<-22	Polar Guard Xtend	25	-	-	-	30	2	115knts for PG
P050	Type IV Validation and New Fluids	1	IP Mod	8	115	<-22	Polar Guard Xtend	75	-	-	-	0	2	No Allowance Time
P051	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	Polar Guard Xtend	-	-	-	-	-	2	Baseline Test
P052	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	Polar Guard Xtend	-	-	-	-	-	1	Baseline Test



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P053	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	Polar Guard Xtend	-	-	-	-	-	2	Baseline Test
P054	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	Polar Guard Xtend	-	-	-	-	-	1	Baseline Test
P055	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	Polar Guard Xtend	-	-	-	-	-	1	Baseline Test
P056	EG Type IV Expansion	1	IP-	8	100	>-5	Max Flight AVIA	25	-	-	-	70	1	Current AT is 50 min
P057	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	Max Flight AVIA	25	10	-	-	50	1	Current AT is 40 min
P058	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	Max Flight AVIA	25	-	13	-	40	2	Current AT is 25 min
P059	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Max Flight AVIA	25	-	25	-	40	1	Current AT is 25 min
P060	EG Type IV Expansion	1	IP- / R-	8	100	>0	Max Flight AVIA	25	-	-	25	40	2	Current AT is 25 min
P061	EG Type IV Expansion	1	IP Mod	8	100	>-5	Max Flight AVIA	75	-	-	-	35	1	Current AT is 25 min
P062	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Max Flight AVIA	75	-	13	-	20	1	Current AT is 10 min
P063	EG Type IV Expansion	1	IP Mod / R	8	100	>0	Max Flight AVIA	75	-	-	75	20	2	Current AT is 10 min
P064	EG Type IV Expansion	1	IP-	8	100	-5 to -10	Max Flight AVIA	25	-	-	-	50	2	Current AT is 30 min
P065	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Max Flight AVIA	25	10	-	-	30	2	Current AT is 15 min
P066	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Max Flight AVIA	25	-	13	-	30	2	Current AT is 10 min
P067	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Max Flight AVIA	25	-	25	-	30	1	Current AT is 10 min
P068	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Max Flight AVIA	75	-	-	-	25	2	Current AT is 10 min
P069	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Max Flight AVIA	75	-	13	-	10	1	Current AT is 7 min
P070	EG Type IV Expansion	1	IP-	8	100	-10 to -16	Max Flight AVIA	25	-	-	-	50	1	Current AT is 30 min
P071	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	Max Flight AVIA	25	10	-	-	30	1	Current AT is 15 min
P072	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	Max Flight AVIA	75	-	-	-	25	1	Current AT is 10 min
P073	EG Type IV Expansion	1	IP-	8	100	-16 to -22	Max Flight AVIA	25	-	-	-	50	2	Current AT is 30 min
P074	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	Max Flight AVIA	25	10	-	-	30	1	No AT exists currently
P075	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	Max Flight AVIA	75	-	-	-	25	2	Current AT is 30 min
P076	EG Type IV Expansion	1	IP-	8	100	<-22	Max Flight AVIA	25	-	-	-	50	2	Current AT is 10 min
P077	EG Type IV Expansion	1	IP Mod	8	100	<-22	Max Flight AVIA	75	-	-	-	25	2	Current AT is - min
P078	EG Type IV Expansion	1	Fluid Only	8	100	>-5	Max Flight AVIA	-	-	-	-	-	2	Baseline Test
P079	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Max Flight AVIA	-	-	-	-	-	1	Baseline Test

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Final Version 1.0, December 20

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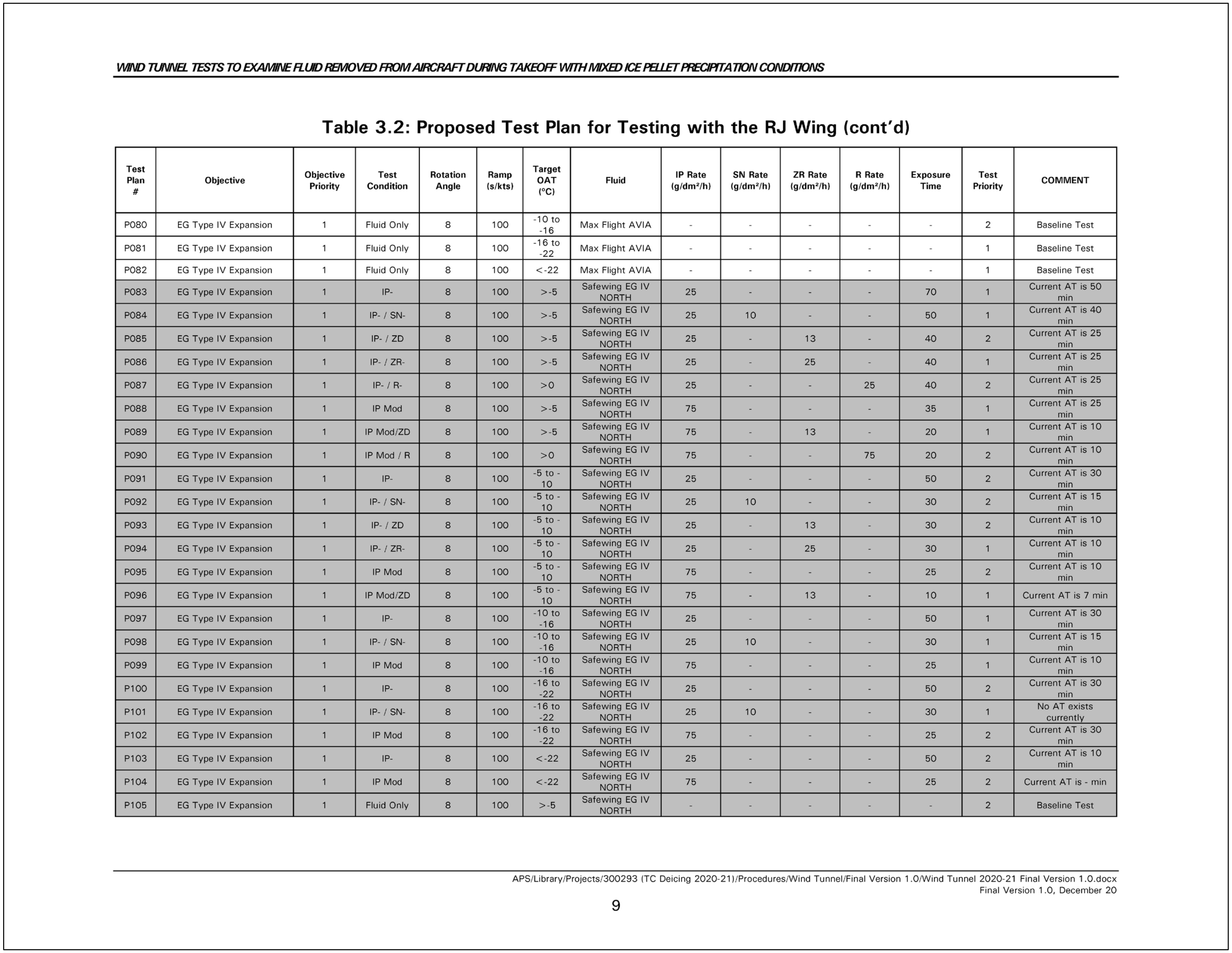


Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P080	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Max Flight AVIA	-	-	-	-	-	2	Baseline Test
P081	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Max Flight AVIA	-	-	-	-	-	1	Baseline Test
P082	EG Type IV Expansion	1	Fluid Only	8	100	<-22	Max Flight AVIA	-	-	-	-	-	1	Baseline Test
P083	EG Type IV Expansion	1	IP-	8	100	>-5	Safewing EG IV NORTH	25	-	-	-	70	1	Current AT is 50 min
P084	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	Safewing EG IV NORTH	25	10	-	-	50	1	Current AT is 40 min
P085	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	Safewing EG IV NORTH	25	-	13	-	40	2	Current AT is 25 min
P086	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Safewing EG IV NORTH	25	-	25	-	40	1	Current AT is 25 min
P087	EG Type IV Expansion	1	IP- / R-	8	100	>0	Safewing EG IV NORTH	25	-	-	25	40	2	Current AT is 25 min
P088	EG Type IV Expansion	1	IP Mod	8	100	>-5	Safewing EG IV NORTH	75	-	-	-	35	1	Current AT is 25 min
P089	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Safewing EG IV NORTH	75	-	13	-	20	1	Current AT is 10 min
P090	EG Type IV Expansion	1	IP Mod / R	8	100	>0	Safewing EG IV NORTH	75	-	-	75	20	2	Current AT is 10 min
P091	EG Type IV Expansion	1	IP-	8	100	-5 to -10	Safewing EG IV NORTH	25	-	-	-	50	2	Current AT is 30 min
P092	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Safewing EG IV NORTH	25	10	-	-	30	2	Current AT is 15 min
P093	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Safewing EG IV NORTH	25	-	13	-	30	2	Current AT is 10 min
P094	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Safewing EG IV NORTH	25	-	25	-	30	1	Current AT is 10 min
P095	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Safewing EG IV NORTH	75	-	-	-	25	2	Current AT is 10 min
P096	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Safewing EG IV NORTH	75	-	13	-	10	1	Current AT is 7 min
P097	EG Type IV Expansion	1	IP-	8	100	-10 to -16	Safewing EG IV NORTH	25	-	-	-	50	1	Current AT is 30 min
P098	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	Safewing EG IV NORTH	25	10	-	-	30	1	Current AT is 15 min
P099	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	Safewing EG IV NORTH	75	-	-	-	25	1	Current AT is 10 min
P100	EG Type IV Expansion	1	IP-	8	100	-16 to -22	Safewing EG IV NORTH	25	-	-	-	50	2	Current AT is 30 min
P101	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	Safewing EG IV NORTH	25	10	-	-	30	1	No AT exists currently
P102	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	Safewing EG IV NORTH	75	-	-	-	25	2	Current AT is 30 min
P103	EG Type IV Expansion	1	IP-	8	100	<-22	Safewing EG IV NORTH	25	-	-	-	50	2	Current AT is 10 min
P104	EG Type IV Expansion	1	IP Mod	8	100	<-22	Safewing EG IV NORTH	75	-	-	-	25	2	Current AT is - min
P105	EG Type IV Expansion	1	Fluid Only	8	100	>-5	Safewing EG IV NORTH	-	-	-	-	-	2	Baseline Test

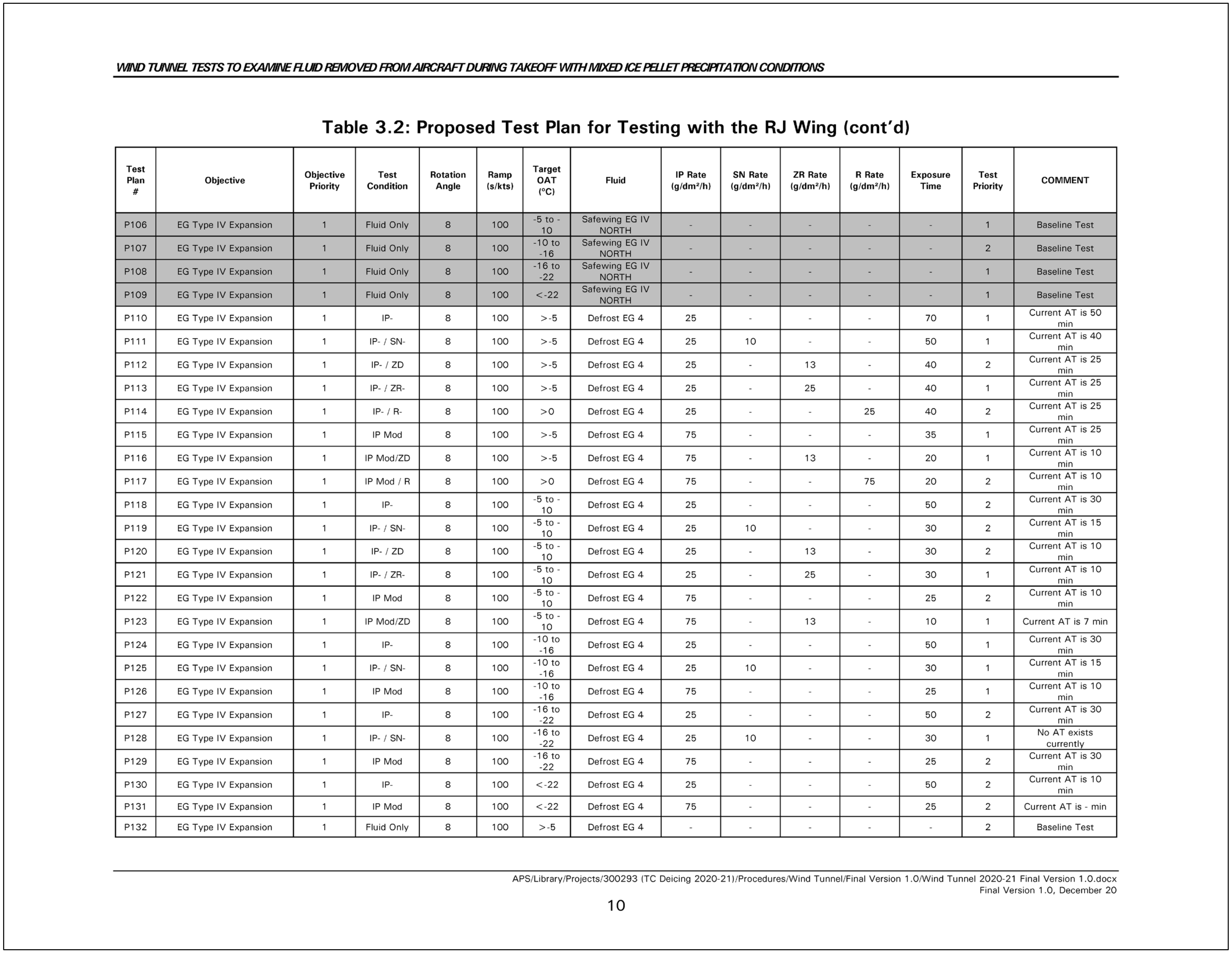


Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P106	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P107	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Safewing EG IV NORTH	-	-	-	-	-	2	Baseline Test
P108	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P109	EG Type IV Expansion	1	Fluid Only	8	100	<-22	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P110	EG Type IV Expansion	1	IP-	8	100	>-5	Defrost EG 4	25	-	-	-	70	1	Current AT is 50 min
P111	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	Defrost EG 4	25	10	-	-	50	1	Current AT is 40 min
P112	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	Defrost EG 4	25	-	13	-	40	2	Current AT is 25 min
P113	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Defrost EG 4	25	-	25	-	40	1	Current AT is 25 min
P114	EG Type IV Expansion	1	IP- / R-	8	100	>0	Defrost EG 4	25	-	-	25	40	2	Current AT is 25 min
P115	EG Type IV Expansion	1	IP Mod	8	100	>-5	Defrost EG 4	75	-	-	-	35	1	Current AT is 25 min
P116	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Defrost EG 4	75	-	13	-	20	1	Current AT is 10 min
P117	EG Type IV Expansion	1	IP Mod / R	8	100	>0	Defrost EG 4	75	-	-	75	20	2	Current AT is 10 min
P118	EG Type IV Expansion	1	IP-	8	100	-5 to -10	Defrost EG 4	25	-	-	-	50	2	Current AT is 30 min
P119	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Defrost EG 4	25	10	-	-	30	2	Current AT is 15 min
P120	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Defrost EG 4	25	-	13	-	30	2	Current AT is 10 min
P121	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Defrost EG 4	25	-	25	-	30	1	Current AT is 10 min
P122	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Defrost EG 4	75	-	-	-	25	2	Current AT is 10 min
P123	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Defrost EG 4	75	-	13	-	10	1	Current AT is 7 min
P124	EG Type IV Expansion	1	IP-	8	100	-10 to -16	Defrost EG 4	25	-	-	-	50	1	Current AT is 30 min
P125	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	Defrost EG 4	25	10	-	-	30	1	Current AT is 15 min
P126	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	Defrost EG 4	75	-	-	-	25	1	Current AT is 10 min
P127	EG Type IV Expansion	1	IP-	8	100	-16 to -22	Defrost EG 4	25	-	-	-	50	2	Current AT is 30 min
P128	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	Defrost EG 4	25	10	-	-	30	1	No AT exists currently
P129	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	Defrost EG 4	75	-	-	-	25	2	Current AT is 30 min
P130	EG Type IV Expansion	1	IP-	8	100	<-22	Defrost EG 4	25	-	-	-	50	2	Current AT is 10 min
P131	EG Type IV Expansion	1	IP Mod	8	100	<-22	Defrost EG 4	75	-	-	-	25	2	Current AT is - min
P132	EG Type IV Expansion	1	Fluid Only	8	100	>-5	Defrost EG 4	-	-	-	-	-	2	Baseline Test

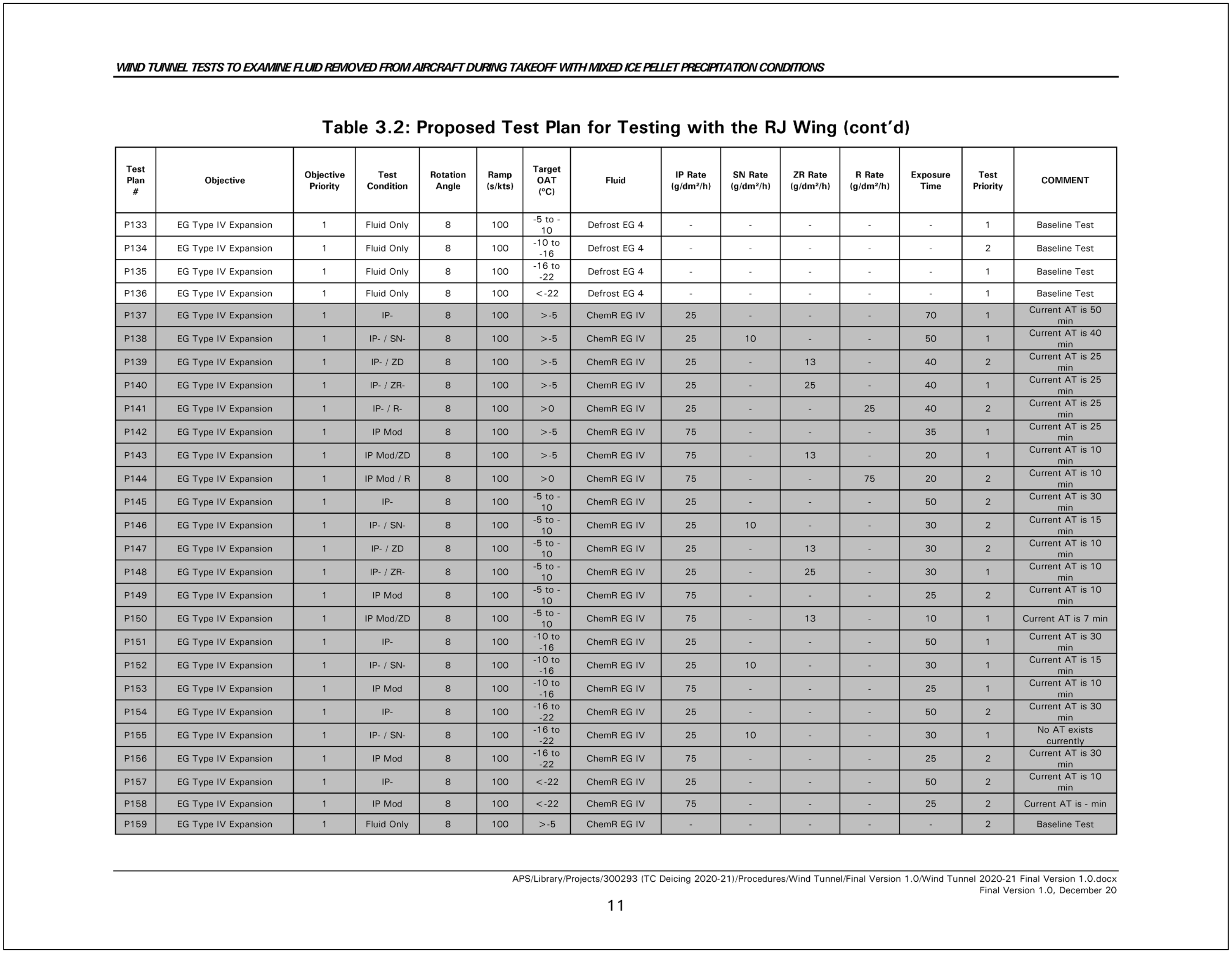


Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P133	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Defrost EG 4	-	-	-	-	-	1	Baseline Test
P134	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Defrost EG 4	-	-	-	-	-	2	Baseline Test
P135	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Defrost EG 4	-	-	-	-	-	1	Baseline Test
P136	EG Type IV Expansion	1	Fluid Only	8	100	<-22	Defrost EG 4	-	-	-	-	-	1	Baseline Test
P137	EG Type IV Expansion	1	IP-	8	100	>-5	ChemR EG IV	25	-	-	-	70	1	Current AT is 50 min
P138	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	ChemR EG IV	25	10	-	-	50	1	Current AT is 40 min
P139	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	ChemR EG IV	25	-	13	-	40	2	Current AT is 25 min
P140	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	ChemR EG IV	25	-	25	-	40	1	Current AT is 25 min
P141	EG Type IV Expansion	1	IP- / R-	8	100	>0	ChemR EG IV	25	-	-	25	40	2	Current AT is 25 min
P142	EG Type IV Expansion	1	IP Mod	8	100	>-5	ChemR EG IV	75	-	-	-	35	1	Current AT is 25 min
P143	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	ChemR EG IV	75	-	13	-	20	1	Current AT is 10 min
P144	EG Type IV Expansion	1	IP Mod / R	8	100	>0	ChemR EG IV	75	-	-	75	20	2	Current AT is 10 min
P145	EG Type IV Expansion	1	IP-	8	100	-5 to -10	ChemR EG IV	25	-	-	-	50	2	Current AT is 30 min
P146	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	ChemR EG IV	25	10	-	-	30	2	Current AT is 15 min
P147	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	ChemR EG IV	25	-	13	-	30	2	Current AT is 10 min
P148	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	ChemR EG IV	25	-	25	-	30	1	Current AT is 10 min
P149	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	ChemR EG IV	75	-	-	-	25	2	Current AT is 10 min
P150	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	ChemR EG IV	75	-	13	-	10	1	Current AT is 7 min
P151	EG Type IV Expansion	1	IP-	8	100	-10 to -16	ChemR EG IV	25	-	-	-	50	1	Current AT is 30 min
P152	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	ChemR EG IV	25	10	-	-	30	1	Current AT is 15 min
P153	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	ChemR EG IV	75	-	-	-	25	1	Current AT is 10 min
P154	EG Type IV Expansion	1	IP-	8	100	-16 to -22	ChemR EG IV	25	-	-	-	50	2	Current AT is 30 min
P155	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	ChemR EG IV	25	10	-	-	30	1	No AT exists currently
P156	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	ChemR EG IV	75	-	-	-	25	2	Current AT is 30 min
P157	EG Type IV Expansion	1	IP-	8	100	<-22	ChemR EG IV	25	-	-	-	50	2	Current AT is 10 min
P158	EG Type IV Expansion	1	IP Mod	8	100	<-22	ChemR EG IV	75	-	-	-	25	2	Current AT is - min
P159	EG Type IV Expansion	1	Fluid Only	8	100	>-5	ChemR EG IV	-	-	-	-	-	2	Baseline Test

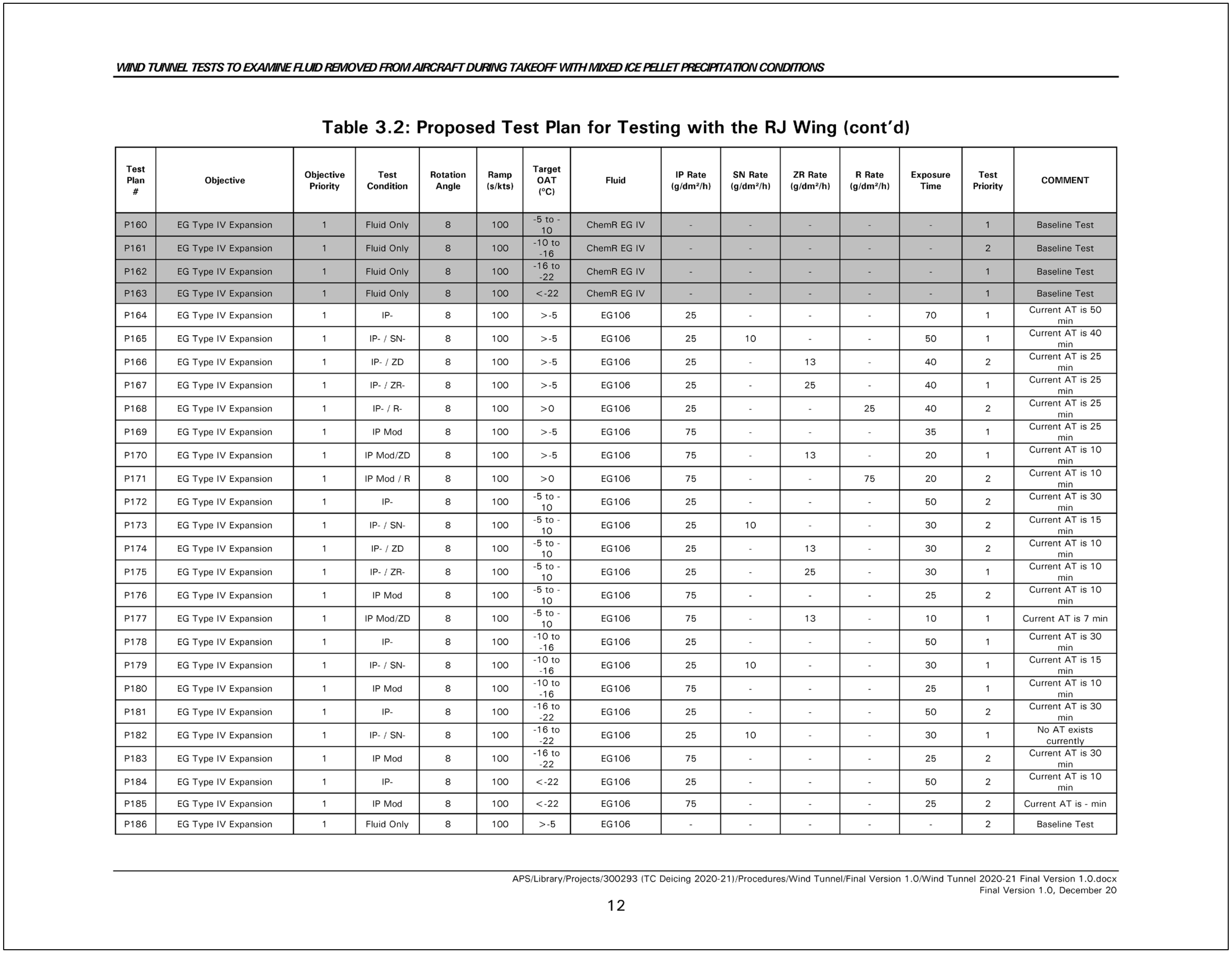


Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P160	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	ChemR EG IV	-	-	-	-	-	1	Baseline Test
P161	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	ChemR EG IV	-	-	-	-	-	2	Baseline Test
P162	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	ChemR EG IV	-	-	-	-	-	1	Baseline Test
P163	EG Type IV Expansion	1	Fluid Only	8	100	<-22	ChemR EG IV	-	-	-	-	-	1	Baseline Test
P164	EG Type IV Expansion	1	IP-	8	100	>-5	EG106	25	-	-	-	70	1	Current AT is 50 min
P165	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	EG106	25	10	-	-	50	1	Current AT is 40 min
P166	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	EG106	25	-	13	-	40	2	Current AT is 25 min
P167	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	EG106	25	-	25	-	40	1	Current AT is 25 min
P168	EG Type IV Expansion	1	IP- / R-	8	100	>0	EG106	25	-	-	25	40	2	Current AT is 25 min
P169	EG Type IV Expansion	1	IP Mod	8	100	>-5	EG106	75	-	-	-	35	1	Current AT is 25 min
P170	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	EG106	75	-	13	-	20	1	Current AT is 10 min
P171	EG Type IV Expansion	1	IP Mod / R	8	100	>0	EG106	75	-	-	75	20	2	Current AT is 10 min
P172	EG Type IV Expansion	1	IP-	8	100	-5 to -10	EG106	25	-	-	-	50	2	Current AT is 30 min
P173	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	EG106	25	10	-	-	30	2	Current AT is 15 min
P174	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	EG106	25	-	13	-	30	2	Current AT is 10 min
P175	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	EG106	25	-	25	-	30	1	Current AT is 10 min
P176	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	EG106	75	-	-	-	25	2	Current AT is 10 min
P177	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	EG106	75	-	13	-	10	1	Current AT is 7 min
P178	EG Type IV Expansion	1	IP-	8	100	-10 to -16	EG106	25	-	-	-	50	1	Current AT is 30 min
P179	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	EG106	25	10	-	-	30	1	Current AT is 15 min
P180	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	EG106	75	-	-	-	25	1	Current AT is 10 min
P181	EG Type IV Expansion	1	IP-	8	100	-16 to -22	EG106	25	-	-	-	50	2	Current AT is 30 min
P182	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	EG106	25	10	-	-	30	1	No AT exists currently
P183	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	EG106	75	-	-	-	25	2	Current AT is 30 min
P184	EG Type IV Expansion	1	IP-	8	100	<-22	EG106	25	-	-	-	50	2	Current AT is 10 min
P185	EG Type IV Expansion	1	IP Mod	8	100	<-22	EG106	75	-	-	-	25	2	Current AT is - min
P186	EG Type IV Expansion	1	Fluid Only	8	100	>-5	EG106	-	-	-	-	-	2	Baseline Test

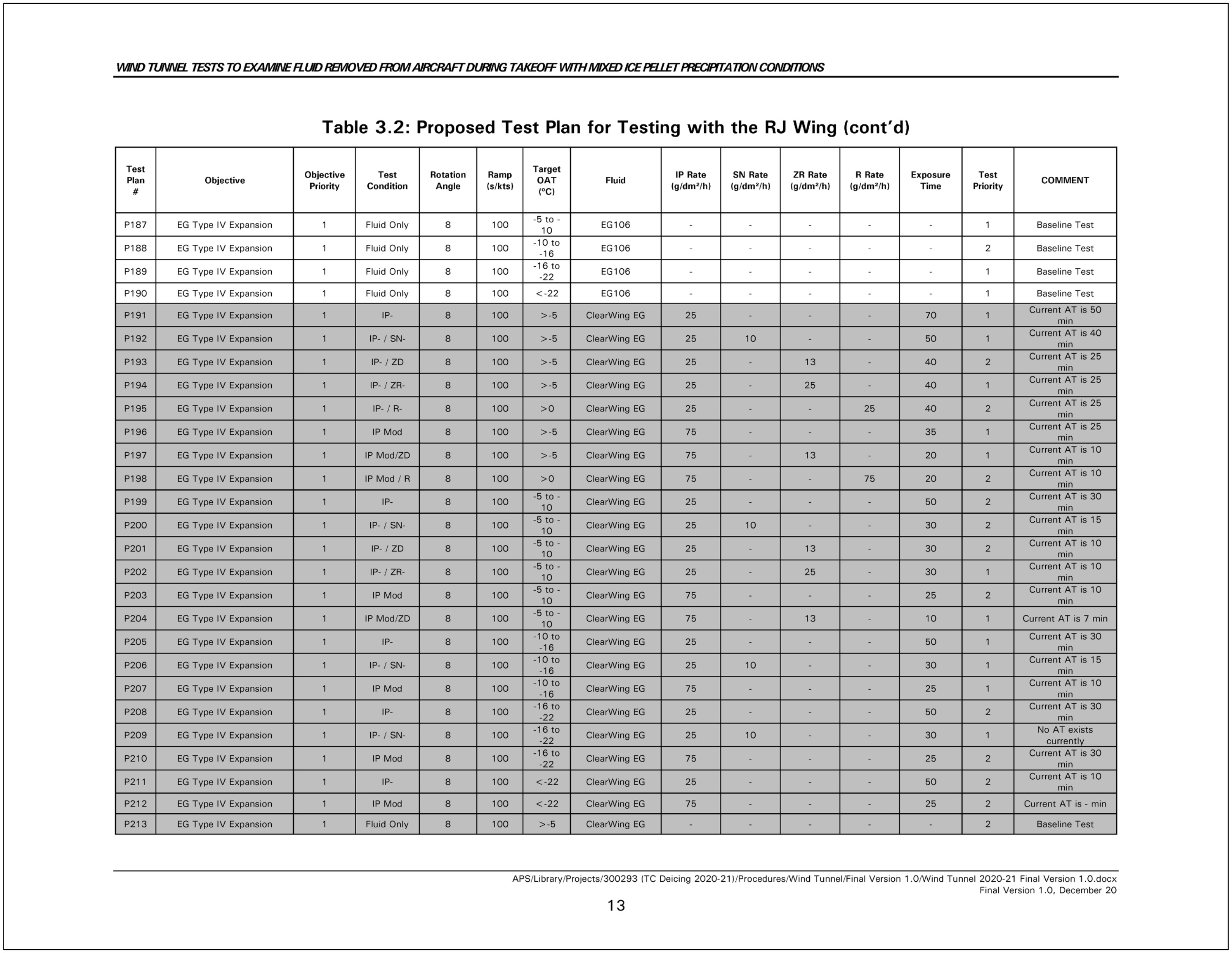
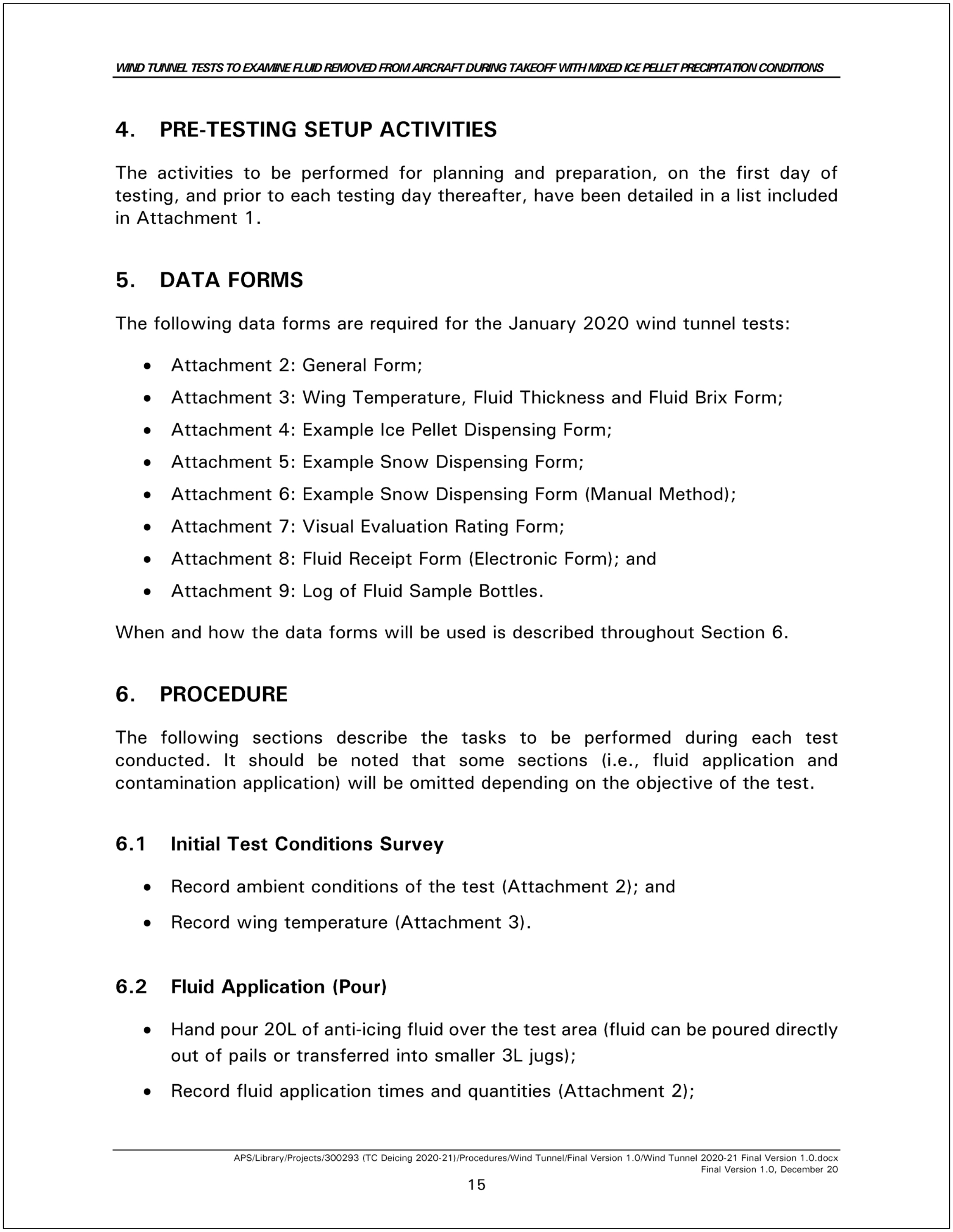


Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P187	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	EG106	-	-	-	-	-	1	Baseline Test
P188	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	EG106	-	-	-	-	-	2	Baseline Test
P189	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	EG106	-	-	-	-	-	1	Baseline Test
P190	EG Type IV Expansion	1	Fluid Only	8	100	<-22	EG106	-	-	-	-	-	1	Baseline Test
P191	EG Type IV Expansion	1	IP-	8	100	>-5	ClearWing EG	25	-	-	-	70	1	Current AT is 50 min
P192	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	ClearWing EG	25	10	-	-	50	1	Current AT is 40 min
P193	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	ClearWing EG	25	-	13	-	40	2	Current AT is 25 min
P194	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	ClearWing EG	25	-	25	-	40	1	Current AT is 25 min
P195	EG Type IV Expansion	1	IP- / R-	8	100	>0	ClearWing EG	25	-	-	25	40	2	Current AT is 25 min
P196	EG Type IV Expansion	1	IP Mod	8	100	>-5	ClearWing EG	75	-	-	-	35	1	Current AT is 25 min
P197	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	ClearWing EG	75	-	13	-	20	1	Current AT is 10 min
P198	EG Type IV Expansion	1	IP Mod / R	8	100	>0	ClearWing EG	75	-	-	75	20	2	Current AT is 10 min
P199	EG Type IV Expansion	1	IP-	8	100	-5 to -10	ClearWing EG	25	-	-	-	50	2	Current AT is 30 min
P200	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	ClearWing EG	25	10	-	-	30	2	Current AT is 15 min
P201	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	ClearWing EG	25	-	13	-	30	2	Current AT is 10 min
P202	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	ClearWing EG	25	-	25	-	30	1	Current AT is 10 min
P203	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	ClearWing EG	75	-	-	-	25	2	Current AT is 10 min
P204	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	ClearWing EG	75	-	13	-	10	1	Current AT is 7 min
P205	EG Type IV Expansion	1	IP-	8	100	-10 to -16	ClearWing EG	25	-	-	-	50	1	Current AT is 30 min
P206	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	ClearWing EG	25	10	-	-	30	1	Current AT is 15 min
P207	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	ClearWing EG	75	-	-	-	25	1	Current AT is 10 min
P208	EG Type IV Expansion	1	IP-	8	100	-16 to -22	ClearWing EG	25	-	-	-	50	2	Current AT is 30 min
P209	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	ClearWing EG	25	10	-	-	30	1	No AT exists currently
P210	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	ClearWing EG	75	-	-	-	25	2	Current AT is 30 min
P211	EG Type IV Expansion	1	IP-	8	100	<-22	ClearWing EG	25	-	-	-	50	2	Current AT is 10 min
P212	EG Type IV Expansion	1	IP Mod	8	100	<-22	ClearWing EG	75	-	-	-	25	2	Current AT is - min
P213	EG Type IV Expansion	1	Fluid Only	8	100	>-5	ClearWing EG	-	-	-	-	-	2	Baseline Test

Table 3.2: Proposed Test Plan for Testing with the RJ Wing (cont'd)

Test Plan #	Objective	Objective Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time	Test Priority	COMMENT
P214	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	ClearWing EG	-	-	-	-	-	1	Baseline Test
P215	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	ClearWing EG	-	-	-	-	-	2	Baseline Test
P216	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P217	EG Type IV Expansion	1	Fluid Only	8	100	<-22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P218	R&D	2	TIII Expansion	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Expand TIII Times
P219	R&D	2	Snow Aero	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Snow Allowance Times
P220	R&D	3	S+++	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Heavy snow
P221	R&D	3	Heavy Cont	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Heavy contamination
P222	R&D	3	LOUT w/ Cont.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Test w/ contamination @ LOUT
P223	R&D	3	Frost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Simulated Frost
P224	R&D	4	IP @ >130kts	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	IP testing a higher speeds
P225	R&D	4	2nd Wave	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	2nd wave of fluid at rot.
P226	R&D	4	V-Stab	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	V-stab fluir+cont
P227	R&D	4	Other	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Other



4. PRE-TESTING SETUP ACTIVITIES

The activities to be performed for planning and preparation, on the first day of testing, and prior to each testing day thereafter, have been detailed in a list included in Attachment 1.

5. DATA FORMS

The following data forms are required for the January 2020 wind tunnel tests:

- Attachment 2: General Form;
- Attachment 3: Wing Temperature, Fluid Thickness and Fluid Brix Form;
- Attachment 4: Example Ice Pellet Dispensing Form;
- Attachment 5: Example Snow Dispensing Form;
- Attachment 6: Example Snow Dispensing Form (Manual Method);
- Attachment 7: Visual Evaluation Rating Form;
- Attachment 8: Fluid Receipt Form (Electronic Form); and
- Attachment 9: Log of Fluid Sample Bottles.

When and how the data forms will be used is described throughout Section 6.

6. PROCEDURE

The following sections describe the tasks to be performed during each test conducted. It should be noted that some sections (i.e., fluid application and contamination application) will be omitted depending on the objective of the test.

6.1 Initial Test Conditions Survey

- Record ambient conditions of the test (Attachment 2); and
- Record wing temperature (Attachment 3).

6.2 Fluid Application (Pour)

- Hand pour 20L of anti-icing fluid over the test area (fluid can be poured directly out of pails or transferred into smaller 3L jugs);
- Record fluid application times and quantities (Attachment 2);

- Let fluid settle for 5-minutes (as the wing section is relatively flat, last winter it required tilting the wing for 1-minute to enable fluid to be uniform);
- Measure fluid thickness at pre-determined locations on the wing (Attachment 3);
- Record wing temperature (Attachment 3);
- Measure fluid Brix value (Attachment 3);
- Photograph and videotape the appearance of the fluid on the wing; and
- Begin the time-lapse camera to gather photos of the precipitation application phase.

Note: At the request of TC/FAA, a standard aluminum test plate can be positioned on the wing to run a simultaneous endurance time test.

6.3 Application of Precipitation

The precipitation that can be generated include the following:

- ZR – 25g/dm²/h;
- R – 25g/dm²/h;
- R – 75g/dm²/h;
- ZD – 5g/dm²/h;
- ZD – 13g/dm²/h;
- SN – 10g/dm²/h;
- SN – 25g/dm²/h;
- IP – 25g/dm²/h; and
- IP – 75g/dm²/h.

6.3.1 Rain, Freezing Rain, Drizzle, and Freezing Drizzle

Freezing precipitation such as rain, freezing rain, drizzle, and freezing drizzle are simulated using an NRC developed sprayer assembly providing a large scan area and appropriate spray uniformity over the test area. The scanner consists of a horizontal main shaft supported by two bearings. The actual spray head assembly is shaft-mounted on a rotating scanner, so that one scan covers a lateral running strip of the test area. A stepper motor is synchronized to index the relative angle of the spray head between scans along an axis perpendicular to the scan axis. This provides two axes of rotation, essentially an x-y plane; one along each axis. Each scan is consecutively indexed to complete the precipitation coverage of the test bed area. This defines one cycle of the spray unit. The scan rate, index angle, and the number of scans per cycle are adjusted, along with the fluid delivery pressures (water and air) to obtain appropriate droplet sizes and precipitation rates. The sprayer system uses compressed air and distilled water to produce freezing rain. The temperature of the water is controlled and is kept just above freezing temperature to produce freezing rain. To produce rain, the temperature of the water is raised until the precipitation no longer freezes on the test surfaces. The sprayer assembly is shown in Photo 6.1.

Photo 6.1: Sprayer Assembly

6.3.2 Ice Pellet/Snow Dispenser Calibration and Set-Up

Calibration work was performed during the winter of 2007-08 on the modified ice pellet/snow dispensers prior to testing with the Falcon 20. The purpose of this calibration work was to attain the dispenser's distribution footprint for both ice pellets and snow. A series of tests were performed in various conditions:

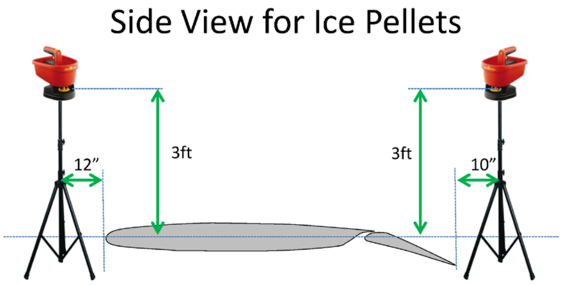
- Ice Pellets, Low Winds (0 to 5 km/h);
- Ice Pellets, Moderate Winds (10 km/h);
- Snow, Low Wind (0 to 5 km/h); and
- Snow, Moderate Wind (10 km/h).

These tests were conducted using 121 collection pans, each measuring 6 x 6 inches, over an area 11 x 11 feet. Pre-measured amounts of ice pellets/snow were dispersed over this area and the amount collected by each pan was recorded. A distribution footprint of the dispenser was attained and efficiency for the dispenser was computed.

6.3.3 Dispensing Ice Pellets/Snow for Wind Tunnel Tests

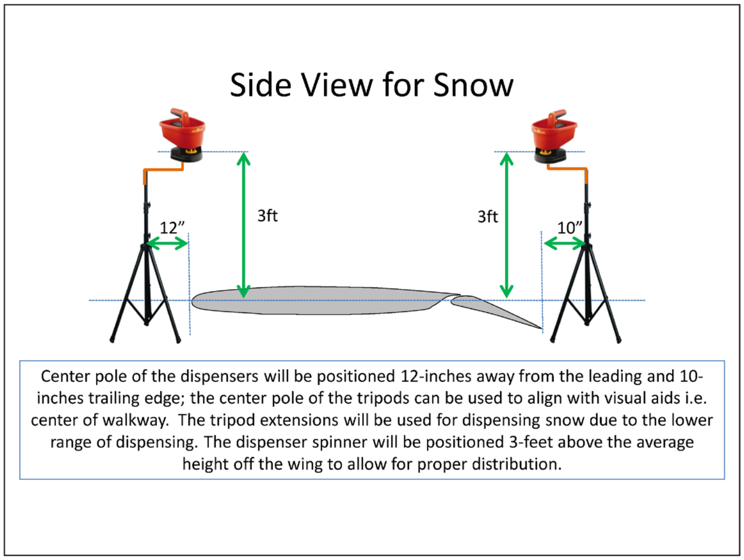
Using the results from these calibration tests, a decision was made to use two dispensers on each of the leading and trailing edges of wing; each of the four dispensers are moved to four different positions along each edge during the dispensing process. Figure 6.1, Figure 6.2, and Figure 6.3 demonstrate the setup of the dispensers in relation to the wing. Attachment 4 and Attachment 5 display the data sheets that will be used during testing in the wind tunnel. These data sheets will provide all the necessary information related to the amount of ice pellets/snow needed, effective rates, and dispenser positions. During the winter of 2009-10, snow was also dispensed manually using sieves. This technique was used when higher rates of precipitation were required (for heavy snow) or when winds in the tunnel made dispensing difficult. The efficiency of this technique was estimated at 90 percent based on how much of the precipitation made it onto the wing and a form to be used for this dispensing process along with dispensing instructions is included in Attachment 6.

Note: Dispensing forms should be filled out and saved for each run and pertinent information shall be included in the general form (Attachment 2). Any comments regarding dispensing activities should be documented directly on the form.



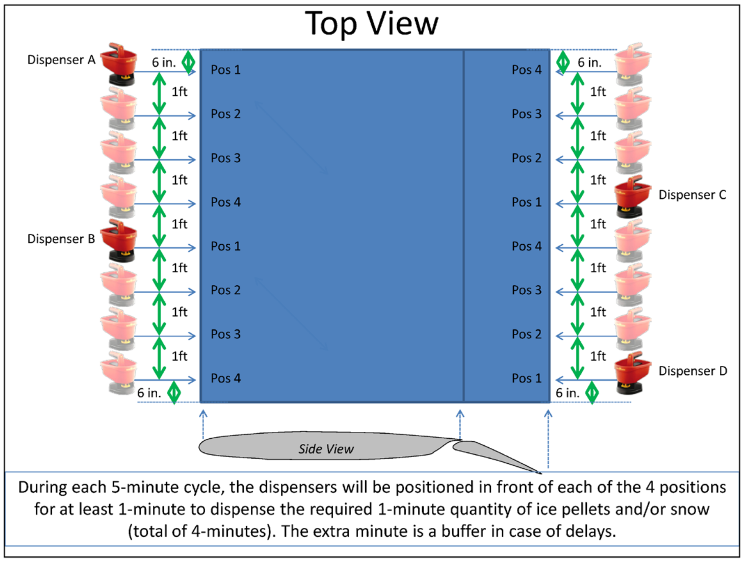
Center pole of the dispensers tripod will be positioned 12-inches away from the leading and 10-inches trailing edge; the center pole of the tripods can be used to align with visual aids i.e. center of walkway. The dispenser spinner will be positioned 3-feet above the average height off the wing to allow for proper distribution.

Figure 6.1: Side View of Positioning of Dispensers Relative to the Wing – Ice Pellets



Center pole of the dispensers will be positioned 12-inches away from the leading and 10-inches trailing edge; the center pole of the tripods can be used to align with visual aids i.e. center of walkway. The tripod extensions will be used for dispensing snow due to the lower range of dispensing. The dispenser spinner will be positioned 3-feet above the average height off the wing to allow for proper distribution.

Figure 6.2: Side View of Positioning of Dispenser Relative to the Wing – Snow



During each 5-minute cycle, the dispensers will be positioned in front of each of the 4 positions for at least 1-minute to dispense the required 1-minute quantity of ice pellets and/or snow (total of 4-minutes). The extra minute is a buffer in case of delays.

Figure 6.3: Top View of Positioning of Dispenser Relative to the Wing

6.3.4 New Ice Pellets/Snow Dispensing Systems for 2014 Onwards

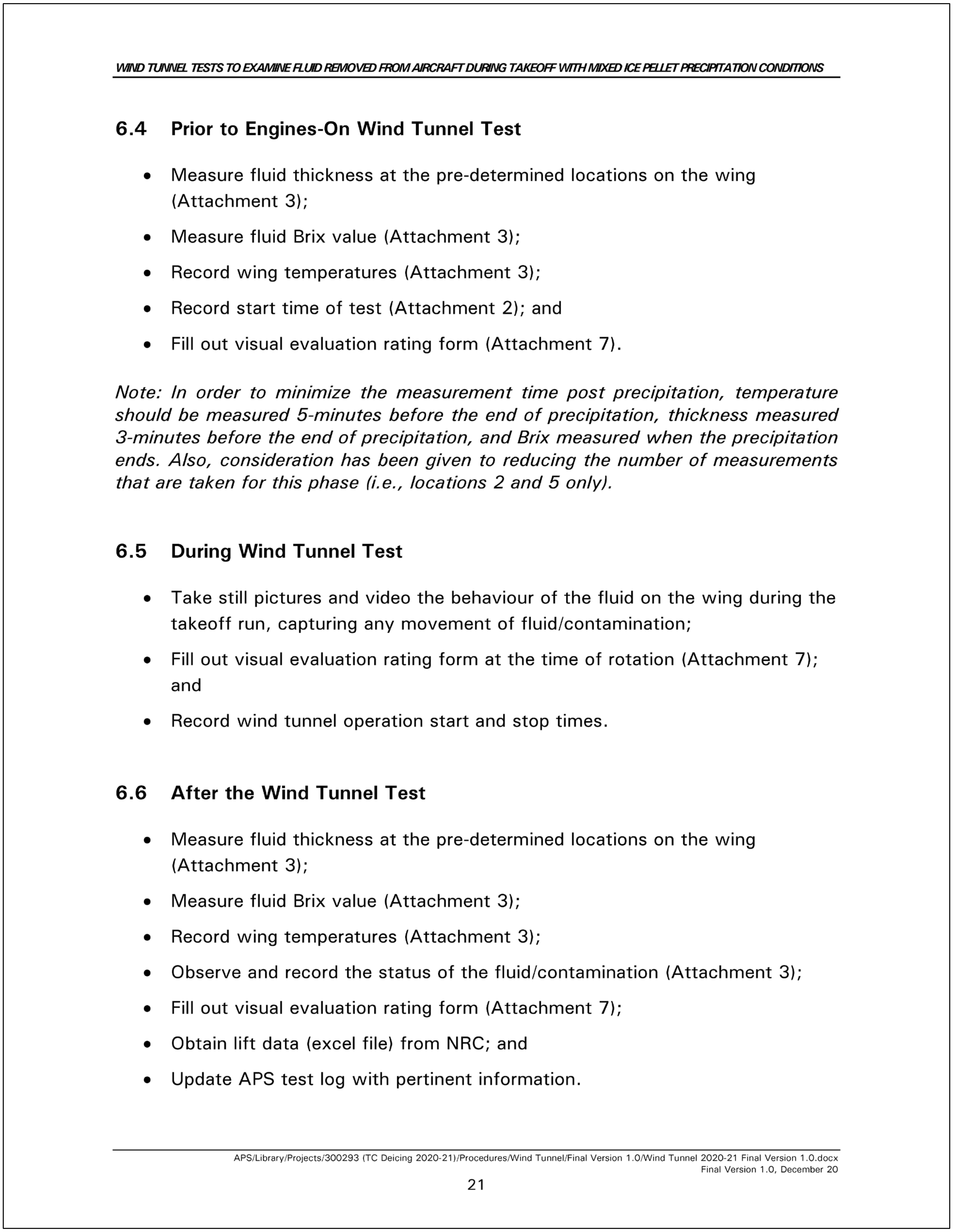
Simulated ice pellets are distributed over a test surface using an ice pellet pitcher. The original ice pellet pitcher (Yardworks) was a modified handheld fertilizer dispenser. The rate of precipitation was controlled with the speed of rotation of the motor, as well as the size of the opening of the dispenser reservoir drop feeder.

In the winter of 2012-13, seed spreaders historically modified and used for applying ice pellets during wind tunnel and flat plate testing, were no longer available as the manufacturer stopped production of the model. A new replacement seed spreader system (Wolf Garten) was found which is similar (but not identical). Some calibration work was required to demonstrate an equivalency in the two systems; testing was conducted at the NRC Climatic Engineering Facility (CEF) prior to the wind tunnel testing to verify the distribution of the historical system versus the new replacement system the details of which are included in the TC report, TP 15230E, *Aircraft Ground Icing General Research Activities During the 2012-13 Winter*.

The data collected demonstrated that the new system is very similar to old system; some small variation was present in distribution within the footprint, but equivalent efficiency on the overall footprint. Based on this, it was concluded that for ice pellets, the new system can be used as a direct replacement. For snow, the new system was more efficient, therefore a reduction of 10 percent should be used for the snow mass requested.

Comparative wind tunnel testing was conducted in the winter of 2013-14 to further validate the equivalency of the systems, the details of which are included in the TC report, TP 15274E, *Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2013-14*. The results indicated that the differences in recorded lift losses were generally very small (less than 1.3 percent) when comparing back-to-back tests with no bias towards one system or the other. The differences were even smaller when looking at the average of the four comparative sequential tests (Test #330 to #337) which was 0.1 percent. In addition, the tests were visually evaluated to verify that the distribution of the ice pellets was similar, further supporting the similarity in aerodynamic results between the two dispenser systems.

In general, the wind tunnel results further supported the original distribution equivalency work conducted during the winter of 2012-13 and demonstrated that the new generation dispensers are suitable replacements for the older model dispensers.



6.4 Prior to Engines-On Wind Tunnel Test

- Measure fluid thickness at the pre-determined locations on the wing (Attachment 3);
- Measure fluid Brix value (Attachment 3);
- Record wing temperatures (Attachment 3);
- Record start time of test (Attachment 2); and
- Fill out visual evaluation rating form (Attachment 7).

Note: In order to minimize the measurement time post precipitation, temperature should be measured 5-minutes before the end of precipitation, thickness measured 3-minutes before the end of precipitation, and Brix measured when the precipitation ends. Also, consideration has been given to reducing the number of measurements that are taken for this phase (i.e., locations 2 and 5 only).

6.5 During Wind Tunnel Test

- Take still pictures and video the behaviour of the fluid on the wing during the takeoff run, capturing any movement of fluid/contamination;
- Fill out visual evaluation rating form at the time of rotation (Attachment 7); and
- Record wind tunnel operation start and stop times.

6.6 After the Wind Tunnel Test

- Measure fluid thickness at the pre-determined locations on the wing (Attachment 3);
- Measure fluid Brix value (Attachment 3);
- Record wing temperatures (Attachment 3);
- Observe and record the status of the fluid/contamination (Attachment 3);
- Fill out visual evaluation rating form (Attachment 7);
- Obtain lift data (excel file) from NRC; and
- Update APS test log with pertinent information.

6.7 Fluid Sample Collection for Viscosity Testing

Two litres of each fluid to be tested are to be collected. The fluid receipt form (Attachment 8) should be completed indicating quantity of fluid and date received. Any samples extracted for viscosity purposes should be documented in the fluid receipt form (Attachment 8), however an additional form (Attachment 9) is available if required. A falling ball viscosity test should be performed to have a reference available if on site testing is required to confirm fluid viscosity before testing.

6.8 At the End of Each Test Session

If required, APS personnel will collect the waste solution. At the end of the testing period, NRC will organize for a glycol recovery service provider to safely dispose of the waste glycol fluid.

6.9 Camera Setup

It is anticipated that the camera setup will be similar to the setup used during the winter of 2013-14. Modifications may be necessary and will be dealt with on-site. The flashes will be positioned on the control-room side of the tunnel, and the cameras will be positioned on the opposite side. The final positioning of the cameras and flashes should be documented to identify any deviation from the previous year's setup.

6.10 Demonstration of a Typical Wind Tunnel Test Sequence

Table 6.1 demonstrates a typical Wind Tunnel test sequence of activities, assuming the test starts at 08:00:00. Figure 6.4 demonstrates a typical wind tunnel run timeline.

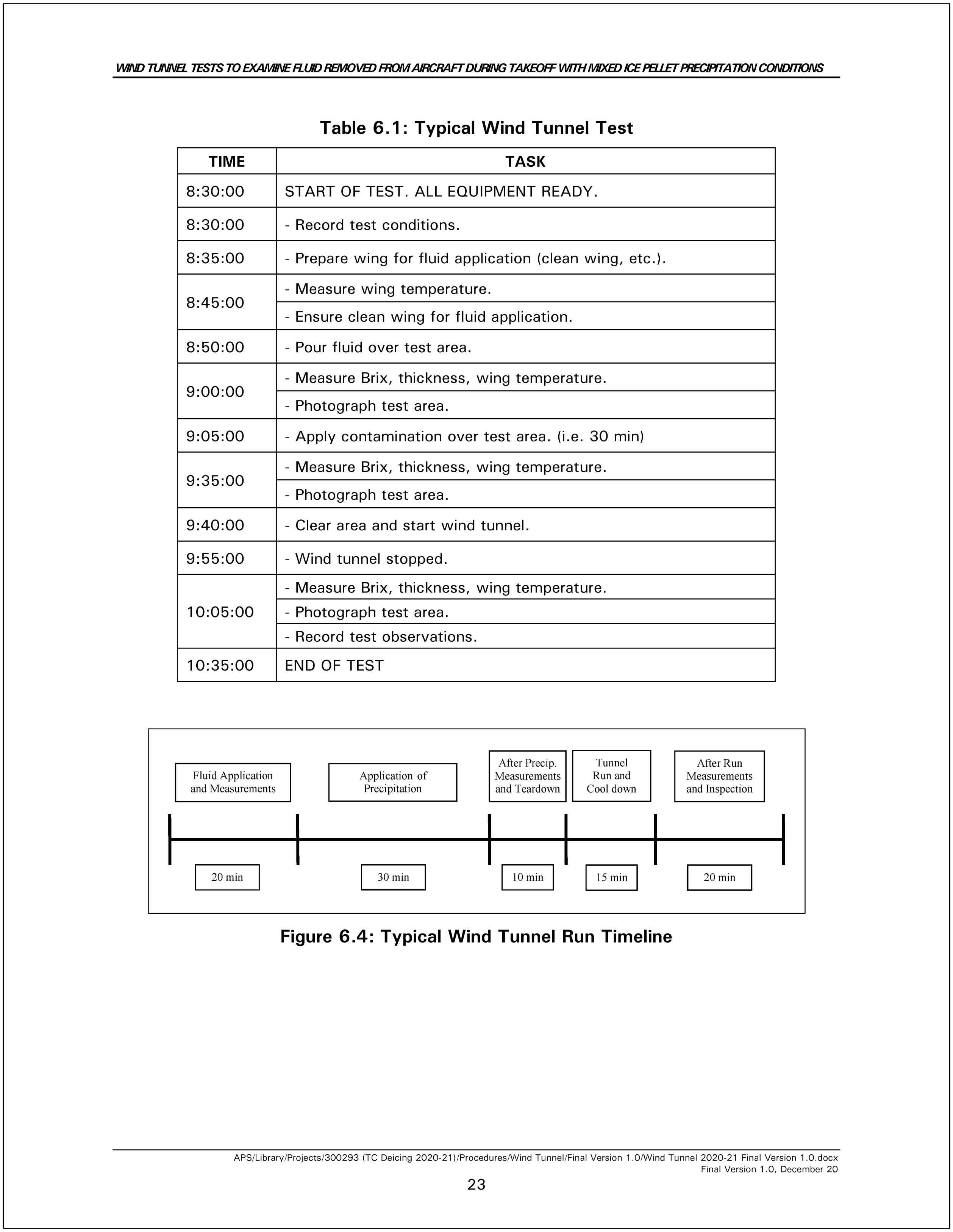


Table 6.1: Typical Wind Tunnel Test

TIME	TASK
8:30:00	START OF TEST. ALL EQUIPMENT READY.
8:30:00	- Record test conditions.
8:35:00	- Prepare wing for fluid application (clean wing, etc.).
8:45:00	- Measure wing temperature.
	- Ensure clean wing for fluid application.
8:50:00	- Pour fluid over test area.
9:00:00	- Measure Brix, thickness, wing temperature.
	- Photograph test area.
9:05:00	- Apply contamination over test area. (i.e. 30 min)
9:35:00	- Measure Brix, thickness, wing temperature.
	- Photograph test area.
9:40:00	- Clear area and start wind tunnel.
9:55:00	- Wind tunnel stopped.
10:05:00	- Measure Brix, thickness, wing temperature.
	- Photograph test area.
	- Record test observations.
10:35:00	END OF TEST

Figure 6.4: Typical Wind Tunnel Run Timeline

6.11 Procedures for Testing Objectives

Details for the testing objectives have been included in the following attachments:

- Attachment 10: Procedure - Dry Wing Performance;
- Attachment 11: Procedure – Type IV Ice Pellet Allowance Time Validation with New Fluids;
- Attachment 12: Procedure – Development of EG Specific Ice Pellet Allowance Time Table;
- Attachment 13: Procedure – Type III Ice Pellet Allowance Time Expansion;
- Attachment 14: Procedure – Snow Allowance Times Using Aerodynamic Data;
- Attachment 15: Procedure - Heavy Snow;
- Attachment 16: Procedure - Heavy Contamination;
- Attachment 17: Procedure - Fluid and Contamination at LOUT;
- Attachment 18: Procedure - Frost Simulation in the Wind Tunnel;
- Attachment 19: Procedure - Feasibility of Ice Pellet Testing at Higher Speeds; and
- Attachment 20: Procedure - 2nd Wave of Fluid during Rotation.
- Attachment 21: Procedure – V-Stab Testing;

7. EQUIPMENT

Equipment to be employed is shown in Table 7.1. Note that crossed off items will not be required for the 2020-21 testing season but have been left in the list for continuity.

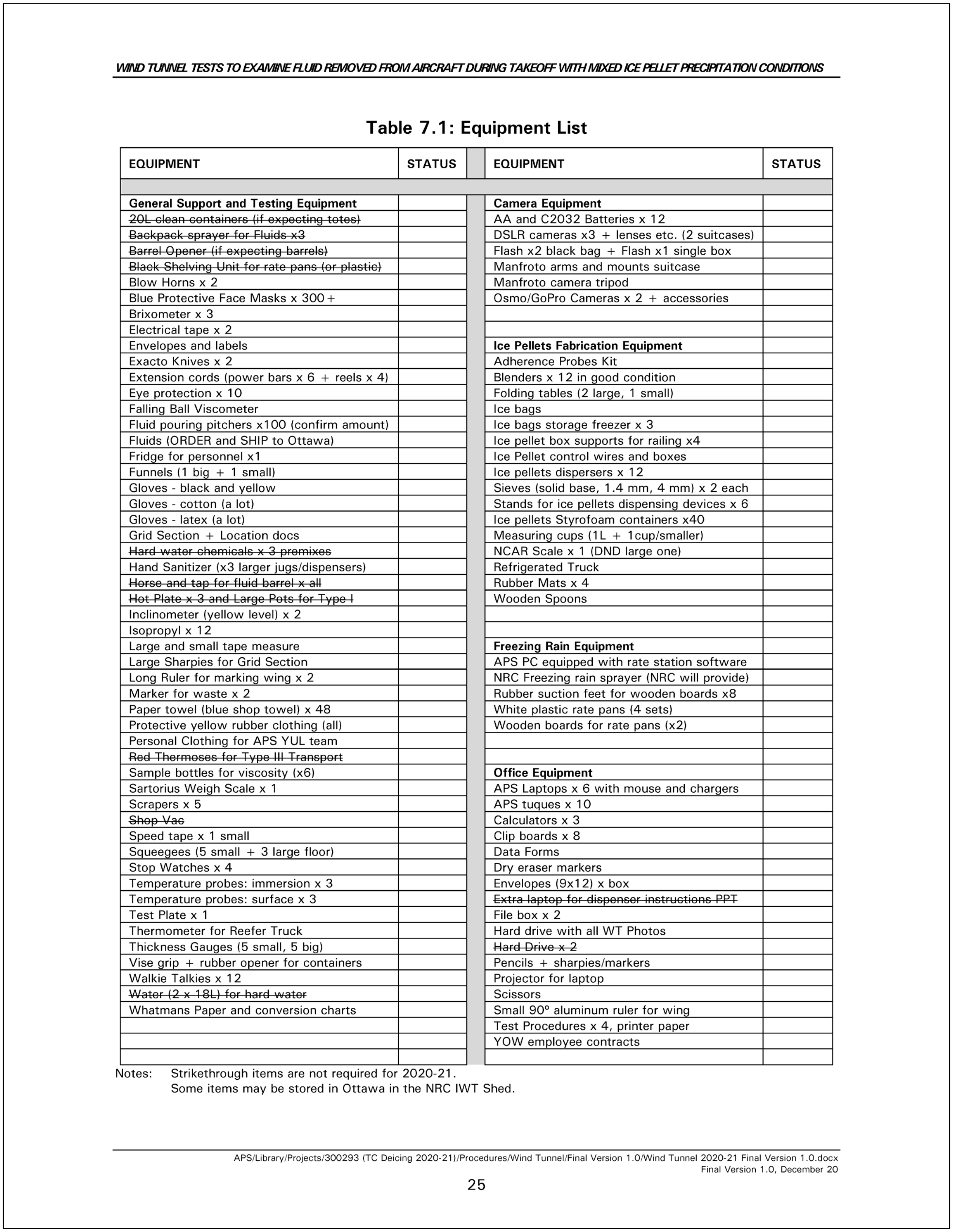
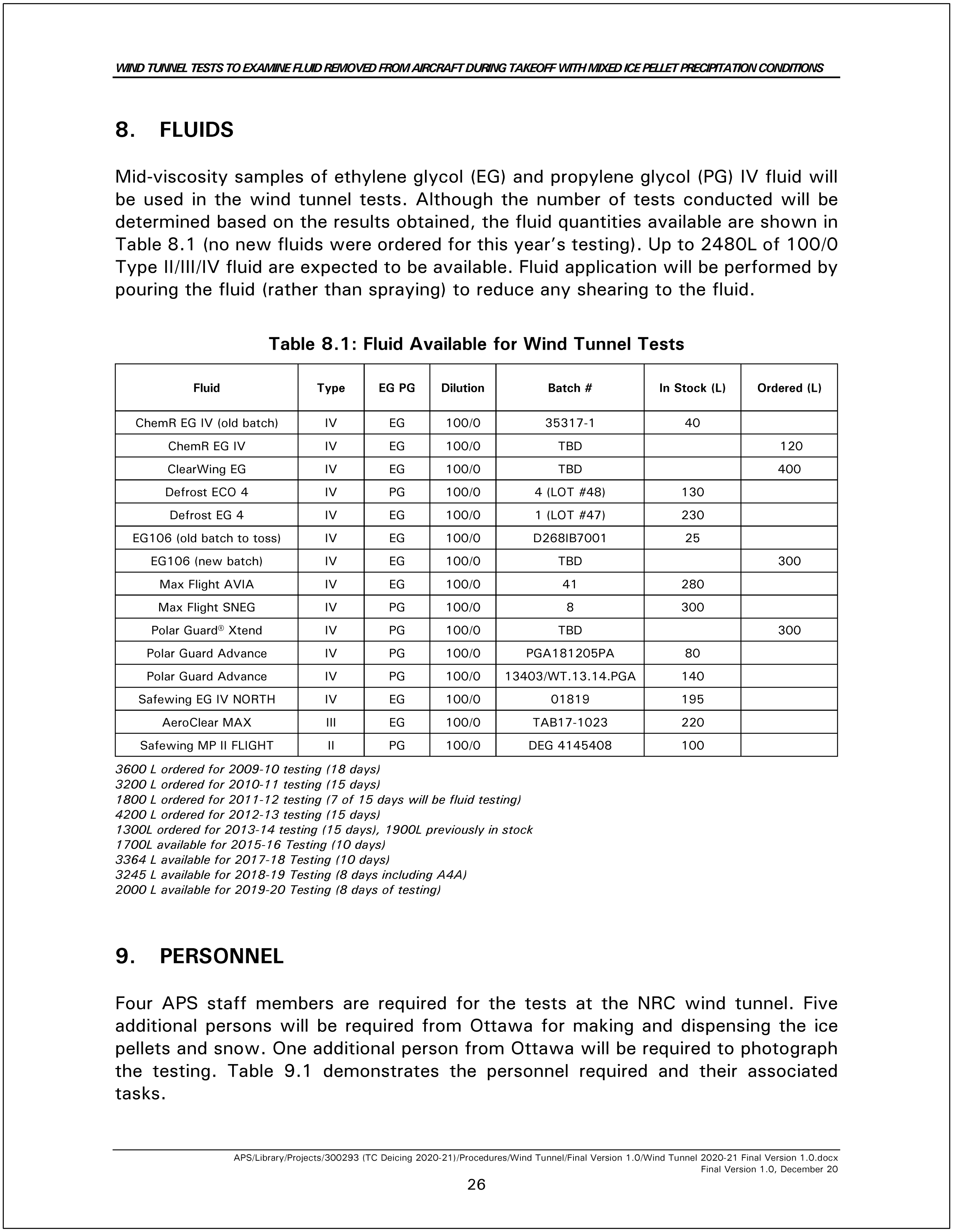


Table 7.1: Equipment List

EQUIPMENT	STATUS
General Support and Testing Equipment	
~~20L clean containers (if expecting totes)~~	
~~Backpack sprayer for Fluids x3~~	
~~Barrel Opener (if expecting barrels)~~	
~~Black Shelving Unit for rate pans (or plastic)~~	
Blow Horns x 2	
Blue Protective Face Masks x 300+	
Brixometer x 3	
Electrical tape x 2	
Envelopes and labels	
Exacto Knives x 2	
Extension cords (power bars x 6 + reels x 4)	
Eye protection x 10	
Falling Ball Viscometer	
Fluid pouring pitchers x100 (confirm amount)	
Fluids (ORDER and SHIP to Ottawa)	
Fridge for personnel x1	
Funnels (1 big + 1 small)	
Gloves - black and yellow	
Gloves - cotton (a lot)	
Gloves - latex (a lot)	
Grid Section + Location docs	
~~Hard water chemicals x 3 premixes~~	
Hand Sanitizer (x3 larger jugs/dispensers)	
~~Horse and tap for fluid barrel x all~~	
~~Hot Plate x 3 and Large Pots for Type I~~	
Inclinometer (yellow level) x 2	
Isopropyl x 12	
Large and small tape measure	
Large Sharpies for Grid Section	
Long Ruler for marking wing x 2	
Marker for waste x 2	
Paper towel (blue shop towel) x 48	
Protective yellow rubber clothing (all)	
Personal Clothing for APS YUL team	
~~Red Thermoses for Type III Transport~~	
Sample bottles for viscosity (x6)	
Sartorius Weigh Scale x 1	
Scrapers x 5	
~~Shop Vac~~	
Speed tape x 1 small	
Squeegees (5 small + 3 large floor)	
Stop Watches x 4	
Temperature probes: immersion x 3	
Temperature probes: surface x 3	
Test Plate x 1	
Thermometer for Reefer Truck	
Thickness Gauges (5 small, 5 big)	
Vise grip + rubber opener for containers	
Walkie Talkies x 12	
~~Water (2 x 18L) for hard water~~	
Whatmans Paper and conversion charts	
Camera Equipment	
AA and C2032 Batteries x 12	
DSLR cameras x3 + lenses etc. (2 suitcases)	
Flash x2 black bag + Flash x1 single box	
Manfroto arms and mounts suitcase	
Manfroto camera tripod	
Osmo/GoPro Cameras x 2 + accessories	
Ice Pellets Fabrication Equipment	
Adherence Probes Kit	
Blenders x 12 in good condition	
Folding tables (2 large, 1 small)	
Ice bags	
Ice bags storage freezer x 3	
Ice pellet box supports for railing x4	
Ice Pellet control wires and boxes	
Ice pellets dispersers x 12	
Sieves (solid base, 1.4 mm, 4 mm) x 2 each	
Stands for ice pellets dispensing devices x 6	
Ice pellets Styrofoam containers x40	
Measuring cups (1L + 1cup/smaller)	
NCAR Scale x 1 (DND large one)	
Refrigerated Truck	
Rubber Mats x 4	
Wooden Spoons	
Freezing Rain Equipment	
APS PC equipped with rate station software	
NRC Freezing rain sprayer (NRC will provide)	
Rubber suction feet for wooden boards x8	
White plastic rate pans (4 sets)	
Wooden boards for rate pans (x2)	
Office Equipment	
APS Laptops x 6 with mouse and chargers	
APS tuques x 10	
Calculators x 3	
Clip boards x 8	
Data Forms	
Dry eraser markers	
Envelopes (9x12) x box	
~~Extra laptop for dispenser instructions PPT~~	
File box x 2	
Hard drive with all WT Photos	
~~Hard Drive x 2~~	
Pencils + sharpies/markers	
Projector for laptop	
Scissors	
Small 90° aluminum ruler for wing	
Test Procedures x 4, printer paper	
YOW employee contracts	

Notes: Strikethrough items are not required for 2020-21.
Some items may be stored in Ottawa in the NRC IWT Shed.



8. FLUIDS

Mid-viscosity samples of ethylene glycol (EG) and propylene glycol (PG) IV fluid will be used in the wind tunnel tests. Although the number of tests conducted will be determined based on the results obtained, the fluid quantities available are shown in Table 8.1 (no new fluids were ordered for this year's testing). Up to 2480L of 100/0 Type II/III/IV fluid are expected to be available. Fluid application will be performed by pouring the fluid (rather than spraying) to reduce any shearing to the fluid.

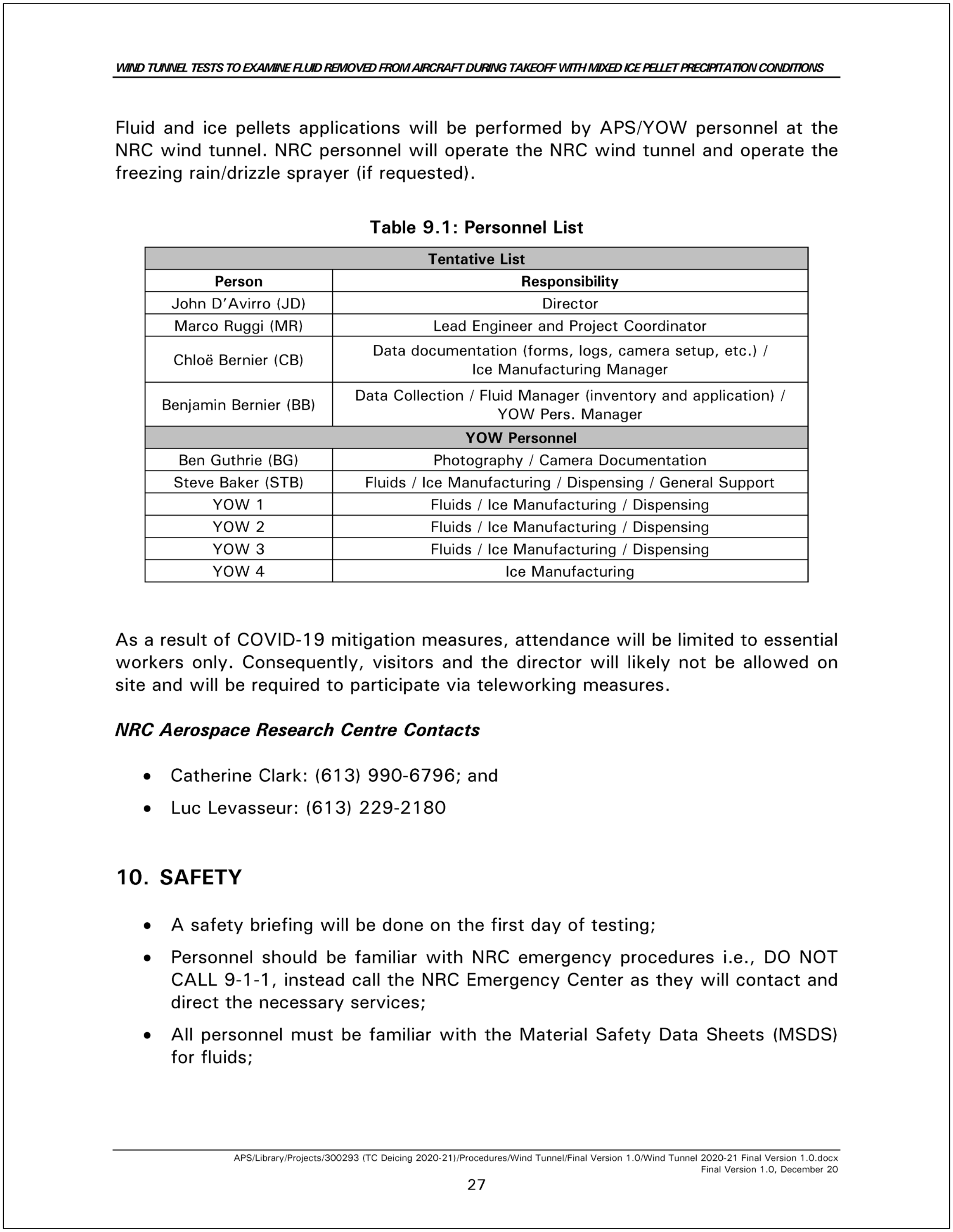
Table 8.1: Fluid Available for Wind Tunnel Tests

Fluid	Type	EG PG	Dilution	Batch #	In Stock (L)	Ordered (L)
ChemR EG IV (old batch)	IV	EG	100/0	35317-1	40	
ChemR EG IV	IV	EG	100/0	TBD		120
ClearWing EG	IV	EG	100/0	TBD		400
Defrost ECO 4	IV	PG	100/0	4 (LOT #48)	130	
Defrost EG 4	IV	EG	100/0	1 (LOT #47)	230	
EG106 (old batch to toss)	IV	EG	100/0	D268IB7001	25	
EG106 (new batch)	IV	EG	100/0	TBD		300
Max Flight AVIA	IV	EG	100/0	41	280	
Max Flight SNEG	IV	PG	100/0	8	300	
Polar Guard® Xtend	IV	PG	100/0	TBD		300
Polar Guard Advance	IV	PG	100/0	PGA181205PA	80	
Polar Guard Advance	IV	PG	100/0	13403/WT.13.14.PGA	140	
Safewing EG IV NORTH	IV	EG	100/0	01819	195	
AeroClear MAX	III	EG	100/0	TAB17-1023	220	
Safewing MP II FLIGHT	II	PG	100/0	DEG 4145408	100	

3600 L ordered for 2009-10 testing (18 days)
3200 L ordered for 2010-11 testing (15 days)
1800 L ordered for 2011-12 testing (7 of 15 days will be fluid testing)
4200 L ordered for 2012-13 testing (15 days)
1300L ordered for 2013-14 testing (15 days), 1900L previously in stock
1700L available for 2015-16 Testing (10 days)
3364 L available for 2017-18 Testing (10 days)
3245 L available for 2018-19 Testing (8 days including A4A)
2000 L available for 2019-20 Testing (8 days of testing)

9. PERSONNEL

Four APS staff members are required for the tests at the NRC wind tunnel. Five additional persons will be required from Ottawa for making and dispensing the ice pellets and snow. One additional person from Ottawa will be required to photograph the testing. Table 9.1 demonstrates the personnel required and their associated tasks.



Fluid and ice pellets applications will be performed by APS/YOW personnel at the NRC wind tunnel. NRC personnel will operate the NRC wind tunnel and operate the freezing rain/drizzle sprayer (if requested).

Table 9.1: Personnel List

Tentative List	
Person	**Responsibility**
John D'Avirro (JD)	Director
Marco Ruggi (MR)	Lead Engineer and Project Coordinator
Chloë Bernier (CB)	Data documentation (forms, logs, camera setup, etc.) / Ice Manufacturing Manager
Benjamin Bernier (BB)	Data Collection / Fluid Manager (inventory and application) / YOW Pers. Manager
YOW Personnel	
Ben Guthrie (BG)	Photography / Camera Documentation
Steve Baker (STB)	Fluids / Ice Manufacturing / Dispensing / General Support
YOW 1	Fluids / Ice Manufacturing / Dispensing
YOW 2	Fluids / Ice Manufacturing / Dispensing
YOW 3	Fluids / Ice Manufacturing / Dispensing
YOW 4	Ice Manufacturing

As a result of COVID-19 mitigation measures, attendance will be limited to essential workers only. Consequently, visitors and the director will likely not be allowed on site and will be required to participate via teleworking measures.

NRC Aerospace Research Centre Contacts

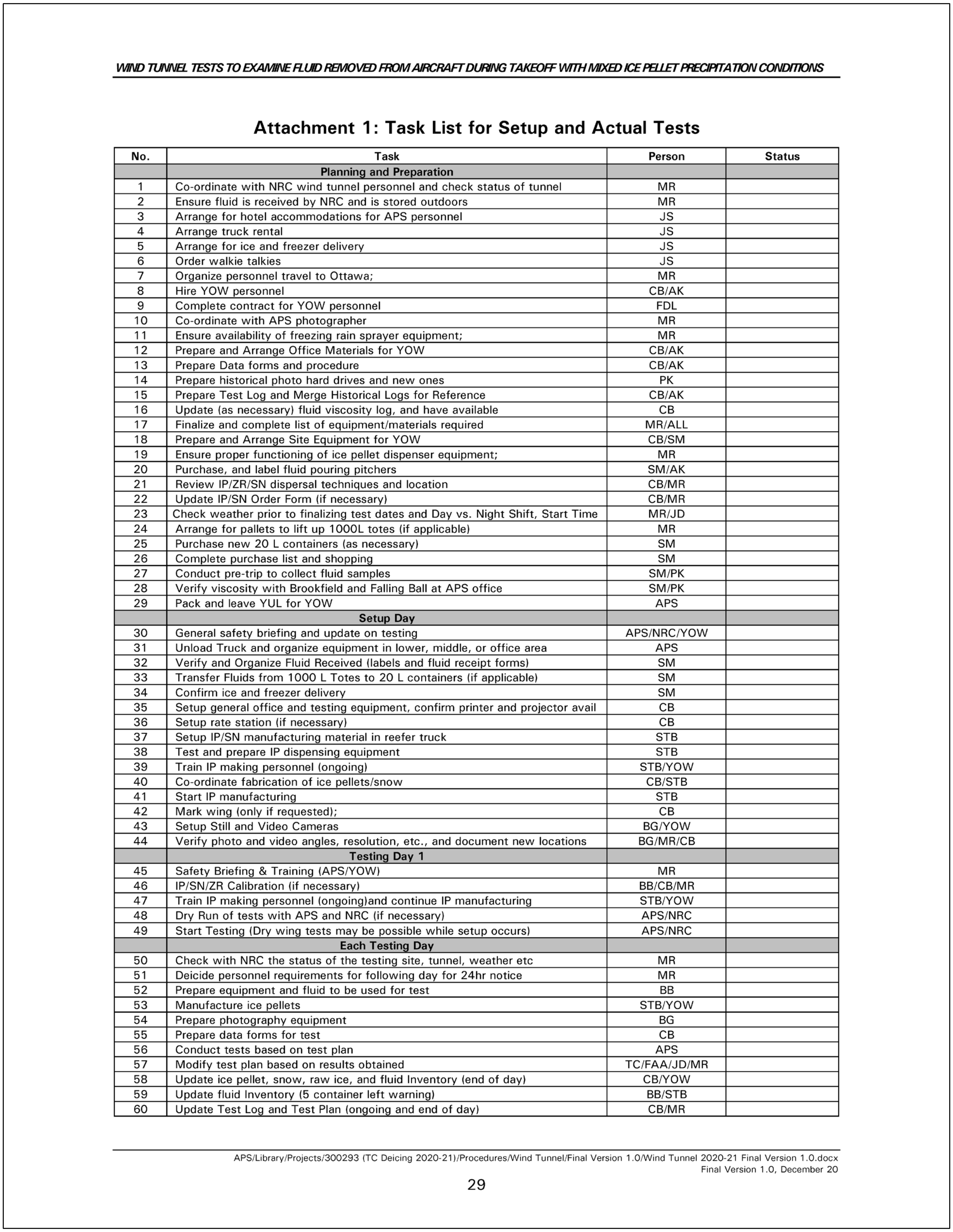
- Catherine Clark: (613) 990-6796; and
- Luc Levasseur: (613) 229-2180

10. SAFETY

- A safety briefing will be done on the first day of testing;
- Personnel should be familiar with NRC emergency procedures i.e., DO NOT CALL 9-1-1, instead call the NRC Emergency Center as they will contact and direct the necessary services;
- All personnel must be familiar with the Material Safety Data Sheets (MSDS) for fluids;

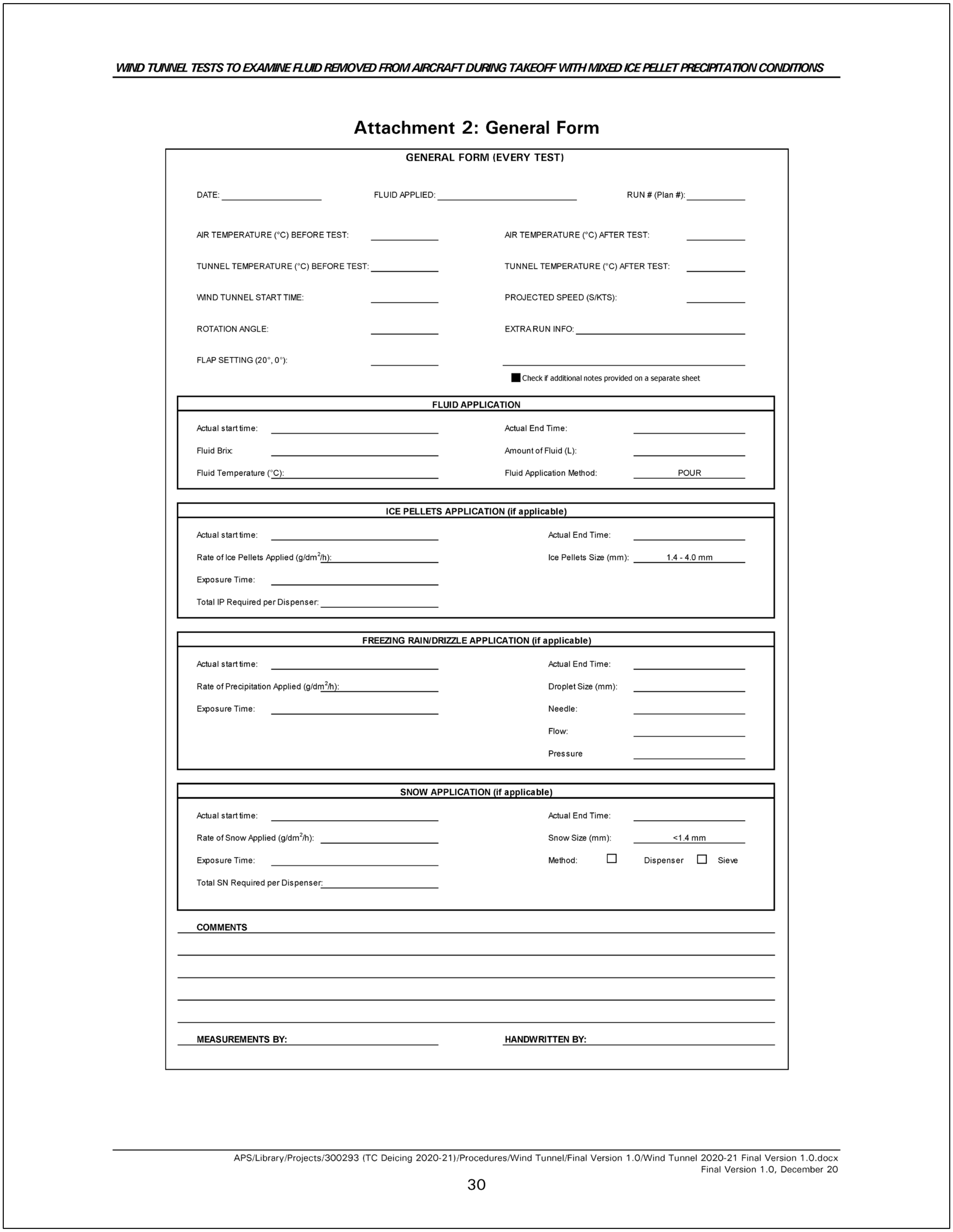
- Prior to operating the wind tunnel, loose objects should be removed from the vicinity;
- When wind tunnel is operating, ensure that ear plugs are worn if necessary and personnel keep safe distances;
- When working on ladders, ensure equipment is stable;
- CSA approved footwear and appropriate clothing for frigid temperatures are to be worn by all personnel;
- Caution should be taken when walking in the test section due to slippery floors, and dripping fluid from the wing section;
- If fluid comes into contact with skin, rinse hands under running water; and
- If fluid comes into contact with eyes, flush with the portable eye wash station.

Separate guidelines related to COVID-19 mitigation strategies will be communicated to staff prior to the start of any activities.



Attachment 1: Task List for Setup and Actual Tests

No.	Task	Person	Status
	Planning and Preparation		
1	Co-ordinate with NRC wind tunnel personnel and check status of tunnel	MR	
2	Ensure fluid is received by NRC and is stored outdoors	MR	
3	Arrange for hotel accommodations for APS personnel	JS	
4	Arrange truck rental	JS	
5	Arrange for ice and freezer delivery	JS	
6	Order walkie talkies	JS	
7	Organize personnel travel to Ottawa;	MR	
8	Hire YOW personnel	CB/AK	
9	Complete contract for YOW personnel	FDL	
10	Co-ordinate with APS photographer	MR	
11	Ensure availability of freezing rain sprayer equipment;	MR	
12	Prepare and Arrange Office Materials for YOW	CB/AK	
13	Prepare Data forms and procedure	CB/AK	
14	Prepare historical photo hard drives and new ones	PK	
15	Prepare Test Log and Merge Historical Logs for Reference	CB/AK	
16	Update (as necessary) fluid viscosity log, and have available	CB	
17	Finalize and complete list of equipment/materials required	MR/ALL	
18	Prepare and Arrange Site Equipment for YOW	CB/SM	
19	Ensure proper functioning of ice pellet dispenser equipment;	MR	
20	Purchase, and label fluid pouring pitchers	SM/AK	
21	Review IP/ZR/SN dispersal techniques and location	CB/MR	
22	Update IP/SN Order Form (if necessary)	CB/MR	
23	Check weather prior to finalizing test dates and Day vs. Night Shift, Start Time	MR/JD	
24	Arrange for pallets to lift up 1000L totes (if applicable)	MR	
25	Purchase new 20 L containers (as necessary)	SM	
26	Complete purchase list and shopping	SM	
27	Conduct pre-trip to collect fluid samples	SM/PK	
28	Verify viscosity with Brookfield and Falling Ball at APS office	SM/PK	
29	Pack and leave YUL for YOW	APS	
	Setup Day		
30	General safety briefing and update on testing	APS/NRC/YOW	
31	Unload Truck and organize equipment in lower, middle, or office area	APS	
32	Verify and Organize Fluid Received (labels and fluid receipt forms)	SM	
33	Transfer Fluids from 1000 L Totes to 20 L containers (if applicable)	SM	
34	Confirm ice and freezer delivery	SM	
35	Setup general office and testing equipment, confirm printer and projector avail	CB	
36	Setup rate station (if necessary)	CB	
37	Setup IP/SN manufacturing material in reefer truck	STB	
38	Test and prepare IP dispensing equipment	STB	
39	Train IP making personnel (ongoing)	STB/YOW	
40	Co-ordinate fabrication of ice pellets/snow	CB/STB	
41	Start IP manufacturing	STB	
42	Mark wing (only if requested);	CB	
43	Setup Still and Video Cameras	BG/YOW	
44	Verify photo and video angles, resolution, etc., and document new locations	BG/MR/CB	
	Testing Day 1		
45	Safety Briefing & Training (APS/YOW)	MR	
46	IP/SN/ZR Calibration (if necessary)	BB/CB/MR	
47	Train IP making personnel (ongoing)and continue IP manufacturing	STB/YOW	
48	Dry Run of tests with APS and NRC (if necessary)	APS/NRC	
49	Start Testing (Dry wing tests may be possible while setup occurs)	APS/NRC	
	Each Testing Day		
50	Check with NRC the status of the testing site, tunnel, weather etc	MR	
51	Deicide personnel requirements for following day for 24hr notice	MR	
52	Prepare equipment and fluid to be used for test	BB	
53	Manufacture ice pellets	STB/YOW	
54	Prepare photography equipment	BG	
55	Prepare data forms for test	CB	
56	Conduct tests based on test plan	APS	
57	Modify test plan based on results obtained	TC/FAA/JD/MR	
58	Update ice pellet, snow, raw ice, and fluid Inventory (end of day)	CB/YOW	
59	Update fluid Inventory (5 container left warning)	BB/STB	
60	Update Test Log and Test Plan (ongoing and end of day)	CB/MR	



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Attachment 2: General Form

GENERAL FORM (EVERY TEST)

DATE: ____ FLUID APPLIED: ____ RUN # (Plan #): ____

AIR TEMPERATURE (°C) BEFORE TEST: ____

AIR TEMPERATURE (°C) AFTER TEST: ____

TUNNEL TEMPERATURE (°C) BEFORE TEST: ____

TUNNEL TEMPERATURE (°C) AFTER TEST: ____

WIND TUNNEL START TIME: ____

PROJECTED SPEED (S/KTS): ____

ROTATION ANGLE: ____

EXTRA RUN INFO: ____

FLAP SETTING (20°, 0°): ____

■ Check if additional notes provided on a separate sheet

FLUID APPLICATION

Actual start time: ____

Actual End Time: ____

Fluid Brix: ____

Amount of Fluid (L): ____

Fluid Temperature (°C): ____

Fluid Application Method: POUR

ICE PELLETS APPLICATION (if applicable)

Actual start time: ____

Actual End Time: ____

Rate of Ice Pellets Applied (g/dm^2/h): ____

Ice Pellets Size (mm): 1.4 - 4.0 mm

Exposure Time: ____

Total IP Required per Dispenser: ____

FREEZING RAIN/DRIZZLE APPLICATION (if applicable)

Actual start time: ____

Actual End Time: ____

Rate of Precipitation Applied (g/dm^2/h): ____

Droplet Size (mm): ____

Exposure Time: ____

Needle: ____

Flow: ____

Pressure ____

SNOW APPLICATION (if applicable)

Actual start time: ____

Actual End Time: ____

Rate of Snow Applied (g/dm^2/h): ____

Snow Size (mm): <1.4 mm

Exposure Time: ____

Method: ☐ Dispenser ☐ Sieve

Total SN Required per Dispenser: ____

COMMENTS ____

MEASUREMENTS BY: ____

HANDWRITTEN BY: ____

APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Final Version 1.0/Wind Tunnel 2020-21 Final Version 1.0.docx
Final Version 1.0, December 20

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Attachment 3: Wing Temperature, Fluid Thickness and Fluid Brix Form

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: ______________________ Run: ______________

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2				
T5				
TU				
Time:				

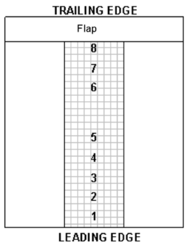
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2			
8			
Flap			
Time:			

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2			
3			
4			
5			
6			
7			
8			
Flap			
Time:			

CYCLE TRACKING

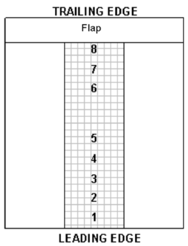
1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: __________



Comments:____________________
____
____
____
____
____

Wing and Plate Condition
After the Takeoff Run
Time: __________



Comments:____________________
____
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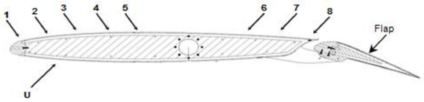


Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

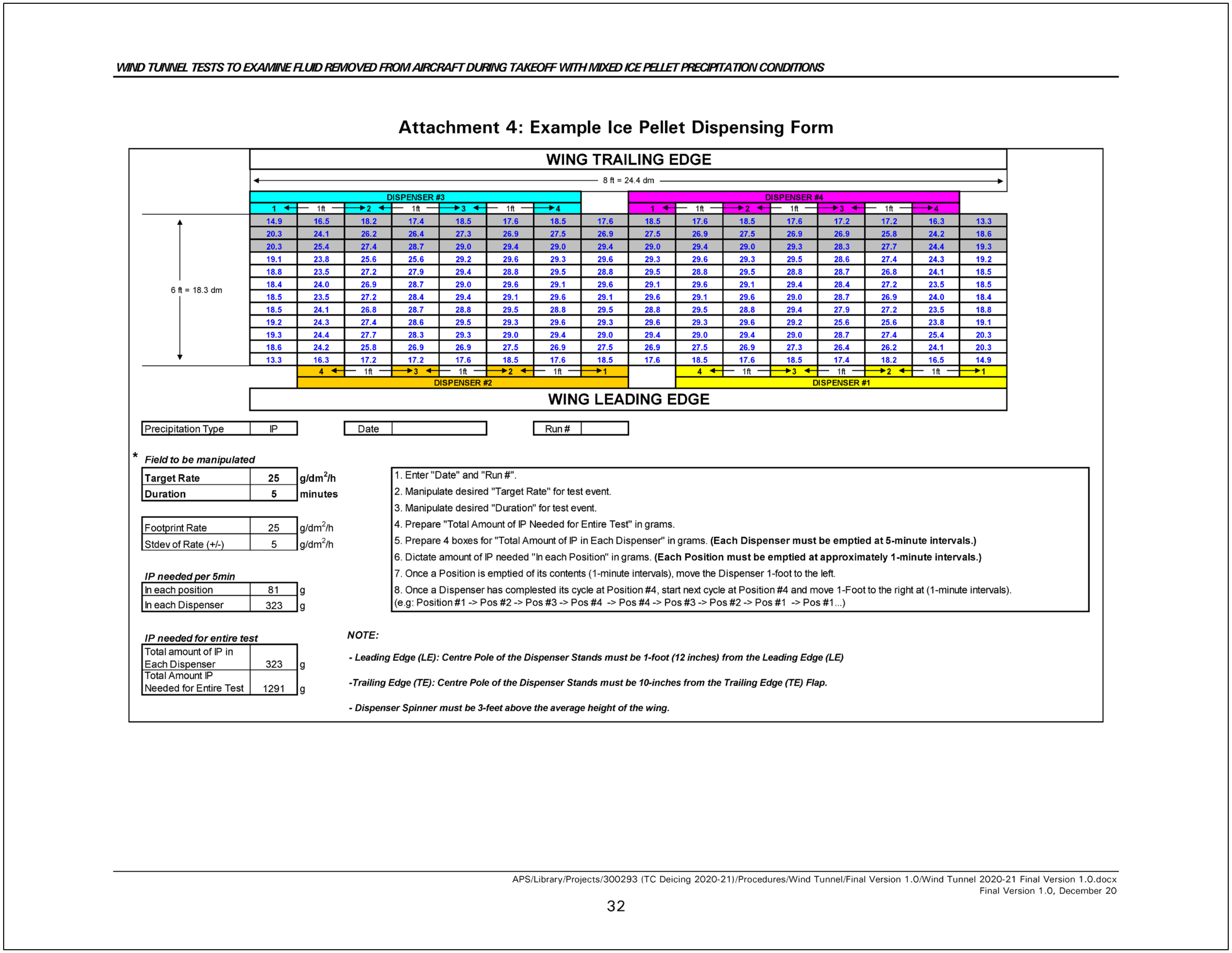
Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______________________________
____
____
____

OBSERVER: ______________________________



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Attachment 4: Example Ice Pellet Dispensing Form

WING TRAILING EDGE

8 ft = 24.4 dm

6 ft = 18.3 dm

DISPENSER #3								DISPENSER #4							
1 ←	1ft	→ 2 ←	1ft	→ 3 ←	1ft	→ 4		1 ←	1ft	→ 2 ←	1ft	→ 3 ←	1ft	→ 4	
14.9	16.5	18.2	17.4	18.5	17.6	18.5	17.6	18.5	17.6	18.5	17.6	17.2	17.2	16.3	13.3
20.3	24.1	26.2	26.4	27.3	26.9	27.5	26.9	27.5	26.9	27.5	26.9	26.9	25.8	24.2	18.6
20.3	25.4	27.4	28.7	29.0	29.4	29.0	29.4	29.0	29.4	29.0	29.3	28.3	27.7	24.4	19.3
19.1	23.8	25.6	25.6	29.2	29.6	29.3	29.6	29.3	29.6	29.3	29.5	28.6	27.4	24.3	19.2
18.8	23.5	27.2	27.9	29.4	28.8	29.5	28.8	29.5	28.8	29.5	28.8	28.7	26.8	24.1	18.5
18.4	24.0	26.9	28.7	29.0	29.6	29.1	29.6	29.1	29.6	29.1	29.4	28.4	27.2	23.5	18.5
18.5	23.5	27.2	28.4	29.4	29.1	29.6	29.1	29.6	29.1	29.6	29.0	28.7	26.9	24.0	18.4
18.5	24.1	26.8	28.7	28.8	29.5	28.8	29.5	28.8	29.5	28.8	29.4	27.9	27.2	23.5	18.8
19.2	24.3	27.4	28.6	29.5	29.3	29.6	29.3	29.6	29.3	29.6	29.2	25.6	25.6	23.8	19.1
19.3	24.4	27.7	28.3	29.3	29.0	29.4	29.0	29.4	29.0	29.4	29.0	28.7	27.4	25.4	20.3
18.6	24.2	25.8	26.9	26.9	27.5	26.9	27.5	26.9	27.5	26.9	27.3	26.4	26.2	24.1	20.3
13.3	16.3	17.2	17.2	17.6	18.5	17.6	18.5	17.6	18.5	17.6	18.5	17.4	18.2	16.5	14.9
	4 ←	1ft	→ 3 ←	1ft	→ 2 ←	1ft	→ 1		4 ←	1ft	→ 3 ←	1ft	→ 2 ←	1ft	→ 1
	DISPENSER #2								DISPENSER #1						

WING LEADING EDGE

Precipitation Type	IP		Date			Run #	

* *Field to be manipulated*

Target Rate	**25**	**g/dm^2/h**
Duration	**5**	**minutes**

Footprint Rate	25	g/dm^2/h
Stdev of Rate (+/-)	5	g/dm^2/h

IP needed per 5min

In each position	81	g
In each Dispenser	323	g

IP needed for entire test

Total amount of IP in Each Dispenser	323	g
Total Amount IP Needed for Entire Test	1291	g

1. Enter "Date" and "Run #".
2. Manipulate desired "Target Rate" for test event.
3. Manipulate desired "Duration" for test event.
4. Prepare "Total Amount of IP Needed for Entire Test" in grams.
5. Prepare 4 boxes for "Total Amount of IP in Each Dispenser" in grams. **(Each Dispenser must be emptied at 5-minute intervals.)**
6. Dictate amount of IP needed "In each Position" in grams. **(Each Position must be emptied at approximately 1-minute intervals.)**
7. Once a Position is emptied of its contents (1-minute intervals), move the Dispenser 1-foot to the left.
8. Once a Dispenser has complested its cycle at Position #4, start next cycle at Position #4 and move 1-Foot to the right at (1-minute intervals). (e.g: Position #1 -> Pos #2 -> Pos #3 -> Pos #4 -> Pos #4 -> Pos #3 -> Pos #2 -> Pos #1 -> Pos #1...)

NOTE:

- Leading Edge (LE): Centre Pole of the Dispenser Stands must be 1-foot (12 inches) from the Leading Edge (LE)

-Trailing Edge (TE): Centre Pole of the Dispenser Stands must be 10-inches from the Trailing Edge (TE) Flap.

- Dispenser Spinner must be 3-feet above the average height of the wing.

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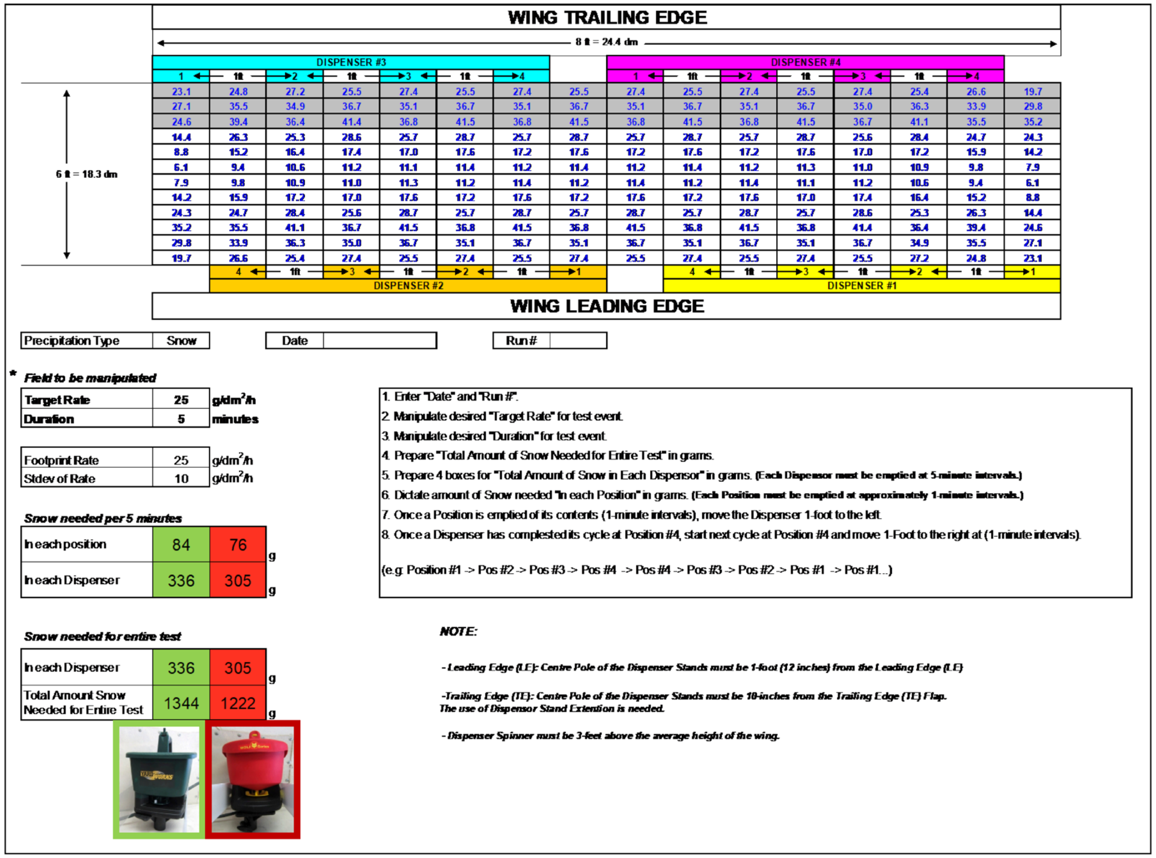
Attachment 5: Example Snow Dispensing Form



WING TRAILING EDGE

8 ft = 24.4 dm

6 ft = 18.3 dm

DISPENSER #3								DISPENSER #4							
1	1ft	2	1ft	3	1ft	4		1	1ft	2	1ft	3	1ft	4	
23.1	24.8	27.2	25.5	27.4	25.5	27.4	25.5	27.4	25.5	27.4	25.5	27.4	25.4	26.6	19.7
27.1	35.5	34.9	36.7	35.1	36.7	35.1	36.7	35.1	36.7	35.1	36.7	35.0	36.3	33.9	29.8
24.6	39.4	36.4	41.4	36.8	41.5	36.8	41.5	36.8	41.5	36.8	41.5	36.7	41.1	35.5	35.2
14.4	26.3	25.3	28.6	25.7	28.7	25.7	28.7	25.7	28.7	25.7	28.7	25.6	28.4	24.7	24.3
8.8	15.2	16.4	17.4	17.0	17.6	17.2	17.6	17.2	17.6	17.2	17.6	17.0	17.2	15.9	14.2
6.1	9.4	10.6	11.2	11.1	11.4	11.2	11.4	11.2	11.4	11.2	11.3	11.0	10.9	9.8	7.9
7.9	9.8	10.9	11.0	11.3	11.2	11.4	11.2	11.4	11.2	11.4	11.1	11.2	10.6	9.4	6.1
14.2	15.9	17.2	17.0	17.6	17.2	17.6	17.2	17.6	17.2	17.6	17.0	17.4	16.4	15.2	8.8
24.3	24.7	28.4	25.6	28.7	25.7	28.7	25.7	28.7	25.7	28.7	25.7	28.6	25.3	26.3	14.4
35.2	35.5	41.1	36.7	41.5	36.8	41.5	36.8	41.5	36.8	41.5	36.8	41.4	36.4	39.4	24.6
29.8	33.9	36.3	35.0	36.7	35.1	36.7	35.1	36.7	35.1	36.7	35.1	36.7	34.9	35.5	27.1
19.7	26.6	25.4	27.4	25.5	27.4	25.5	27.4	25.5	27.4	25.5	27.4	25.5	27.2	24.8	23.1
	4	1ft	3	1ft	2	1ft	1		4	1ft	3	1ft	2	1ft	1
	DISPENSER #2								DISPENSER #1						

WING LEADING EDGE

Precipitation Type	Snow		Date		Run#	

* ***Field to be manipulated***

Target Rate	**25**	**g/dm²/h**
Duration	**5**	**minutes**

Footprint Rate	25	g/dm²/h
Stdev of Rate	10	g/dm²/h

Snow needed per 5 minutes

In each position	84	76	g
In each Dispenser	336	305	g

Snow needed for entire test

In each Dispenser	336	305	g
Total Amount Snow Needed for Entire Test	1344	1222	g

1. Enter "Date" and "Run #".
2. Manipulate desired "Target Rate" for test event.
3. Manipulate desired "Duration" for test event.
4. Prepare "Total Amount of Snow Needed for Entire Test" in grams.
5. Prepare 4 boxes for "Total Amount of Snow in Each Dispensor" in grams. **(Each Dispensor must be emptied at 5-minute intervals.)**
6. Dictate amount of Snow needed "In each Position" in grams. **(Each Position must be emptied at approximately 1-minute intervals.)**
7. Once a Position is emptied of its contents (1-minute intervals), move the Dispenser 1-foot to the left.
8. Once a Dispenser has complested its cycle at Position #4, start next cycle at Position #4 and move 1-Foot to the right at (1-minute intervals).

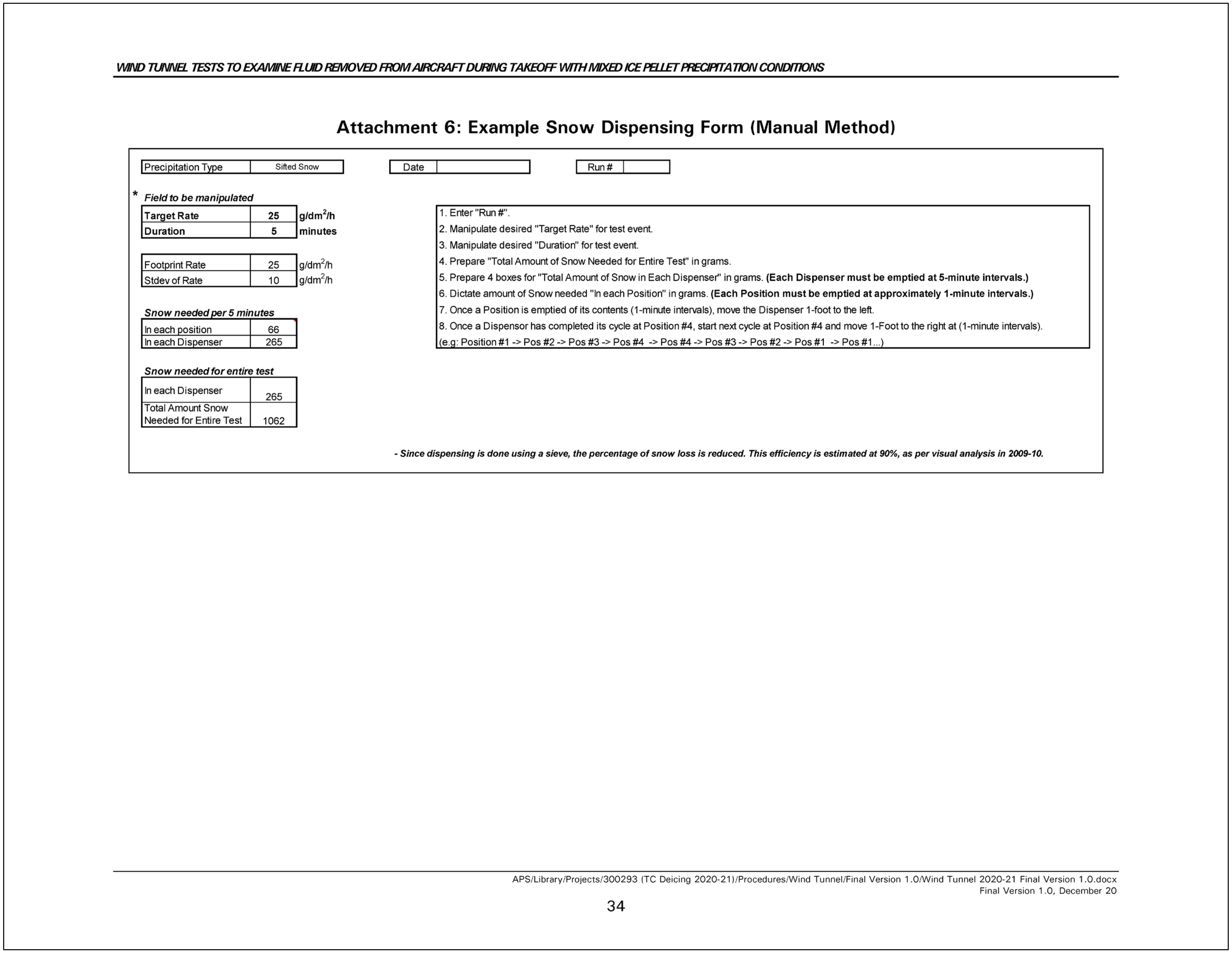
(e.g. Position #1 -> Pos #2 -> Pos #3 -> Pos #4 -> Pos #4 -> Pos #3 -> Pos #2 -> Pos #1 -> Pos #1...)

NOTE:

- Leading Edge (LE): Centre Pole of the Dispenser Stands must be 1-foot (12 inches) from the Leading Edge (LE)

-Trailing Edge (TE): Centre Pole of the Dispenser Stands must be 10-inches from the Trailing Edge (TE) Flap. The use of Dispensor Stand Extention is needed.

- Dispenser Spinner must be 3-feet above the average height of the wing.



Attachment 6: Example Snow Dispensing Form (Manual Method)

Precipitation Type	Sifted Snow

Date	

Run #	

* *Field to be manipulated*

Target Rate	**25**	**g/dm²/h**
Duration	**5**	**minutes**

Footprint Rate	25	g/dm²/h
Stdev of Rate	10	g/dm²/h

Snow needed per 5 minutes

In each position	66
In each Dispenser	265

Snow needed for entire test

In each Dispenser	265
Total Amount Snow Needed for Entire Test	1062

1. Enter "Run #".
2. Manipulate desired "Target Rate" for test event.
3. Manipulate desired "Duration" for test event.
4. Prepare "Total Amount of Snow Needed for Entire Test" in grams.
5. Prepare 4 boxes for "Total Amount of Snow in Each Dispenser" in grams. **(Each Dispenser must be emptied at 5-minute intervals.)**
6. Dictate amount of Snow needed "In each Position" in grams. **(Each Position must be emptied at approximately 1-minute intervals.)**
7. Once a Position is emptied of its contents (1-minute intervals), move the Dispenser 1-foot to the left.
8. Once a Dispensor has completed its cycle at Position #4, start next cycle at Position #4 and move 1-Foot to the right at (1-minute intervals).
(e.g: Position #1 -> Pos #2 -> Pos #3 -> Pos #4 -> Pos #4 -> Pos #3 -> Pos #2 -> Pos #1 -> Pos #1...)

- Since dispensing is done using a sieve, the percentage of snow loss is reduced. This efficiency is estimated at 90%, as per visual analysis in 2009-10.

Attachment 7: Visual Evaluation Rating Form

VISUAL EVALUATION RATING OF CONDITION OF WING

Date: ______________________ Run Number: ________

Ratings:

1 - Contamination not very visible, fluid still clean.
2 - Contamination is visible, but lots of fluid still present
3 - Contamination visible, spots of bridging contamination
4 - Contamination visible, lots of dry bridging present
5 - Contamination visible, adherence of contamination

Note: Ratings can include decimals i.e. 1.4 or 3.5

Before Take-off Run

Area	Visual Severity Rating (1-5)	
Leading Edge		*>3 = Review, >3.5=Bad*
Trailing Edge		*>3 = Review, >3.5=Bad*
Flap		*>4 = Review, >4.5=Bad*

At Rotation

Area	Visual Severity Rating (1-5)		Expected Lift Loss (%) *>5.4 = Review* *>9.2 = Bad*
Leading Edge		*>1= Review >1.5 = Bad*	
Trailing Edge			
Flap			

After Take-off Run

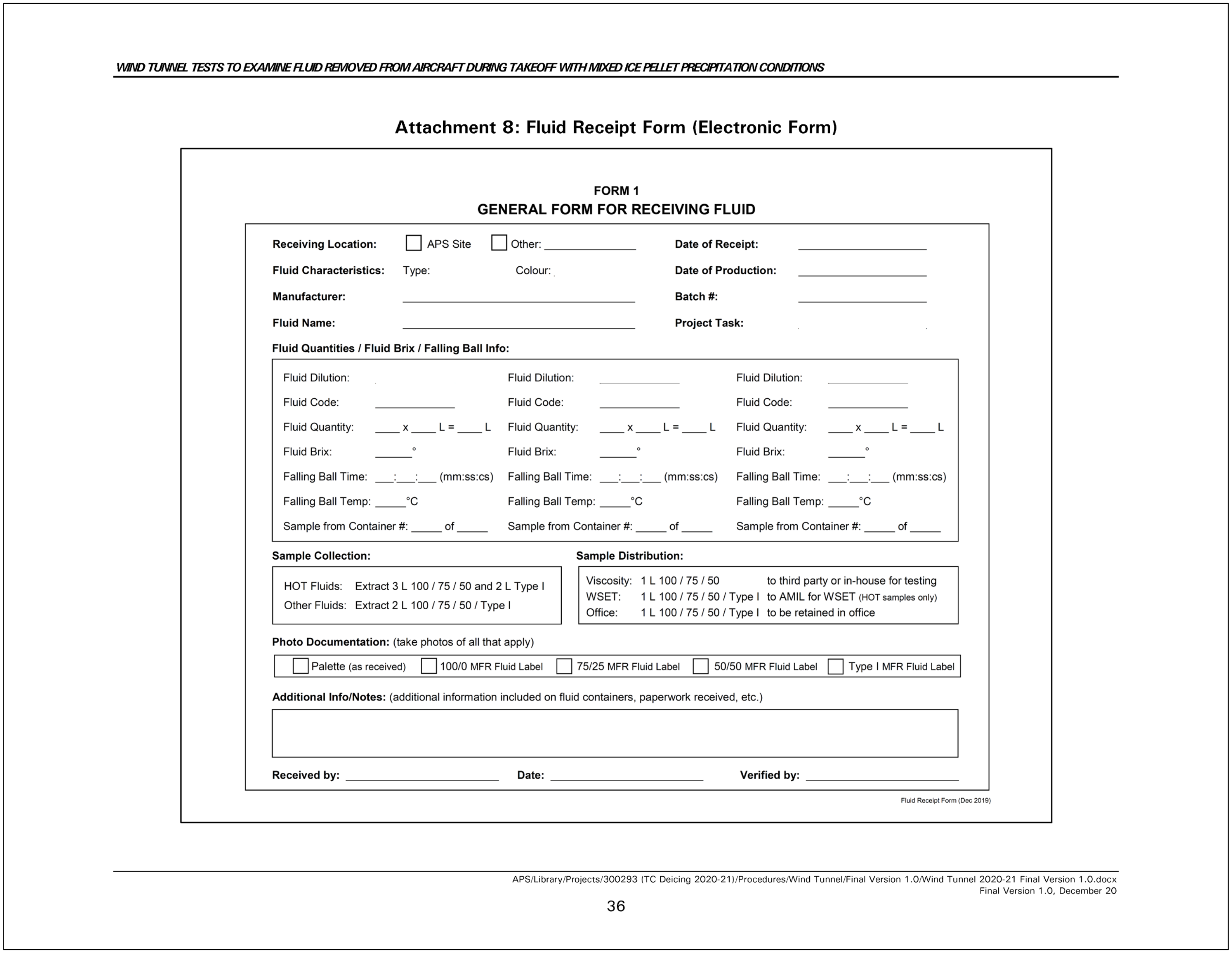
Area	Visual Severity Rating (1-5)
Leading Edge	
Trailing Edge	
Flap	

Additional Observations: ______________________________

____

____

OBSERVER:__________________________



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Attachment 8: Fluid Receipt Form (Electronic Form)

FORM 1
GENERAL FORM FOR RECEIVING FLUID

Receiving Location: ☐ APS Site ☐ Other: ______________ **Date of Receipt:** ____________________

Fluid Characteristics: Type: Colour: **Date of Production:** ____________________

Manufacturer: ____________________________________ **Batch #:** ____________________

Fluid Name: ____________________________________ **Project Task:**

Fluid Quantities / Fluid Brix / Falling Ball Info:

Fluid Dilution:	Fluid Dilution: ____________	Fluid Dilution: ____________
Fluid Code: ____________	Fluid Code: ____________	Fluid Code: ____________
Fluid Quantity: ____ x ____ L = ____ L	Fluid Quantity: ____ x ____ L = ____ L	Fluid Quantity: ____ x ____ L = ____ L
Fluid Brix: ______°	Fluid Brix: ______°	Fluid Brix: ______°
Falling Ball Time: ___:___:___ (mm:ss:cs)	Falling Ball Time: ___:___:___ (mm:ss:cs)	Falling Ball Time: ___:___:___ (mm:ss:cs)
Falling Ball Temp: _____°C	Falling Ball Temp: _____°C	Falling Ball Temp: _____°C
Sample from Container #: _____ of _____	Sample from Container #: _____ of _____	Sample from Container #: _____ of _____

Sample Collection:

HOT Fluids:	Extract 3 L 100 / 75 / 50 and 2 L Type I
Other Fluids:	Extract 2 L 100 / 75 / 50 / Type I

Sample Distribution:

Viscosity:	1 L 100 / 75 / 50	to third party or in-house for testing
WSET:	1 L 100 / 75 / 50 / Type I	to AMIL for WSET (HOT samples only)
Office:	1 L 100 / 75 / 50 / Type I	to be retained in office

Photo Documentation: (take photos of all that apply)

☐ Palette (as received) ☐ 100/0 MFR Fluid Label ☐ 75/25 MFR Fluid Label ☐ 50/50 MFR Fluid Label ☐ Type I MFR Fluid Label

Additional Info/Notes: (additional information included on fluid containers, paperwork received, etc.)

Received by: ________________________ **Date:** ________________________ **Verified by:** ________________________

Fluid Receipt Form (Dec 2019)

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Final Version 1.0, December 20

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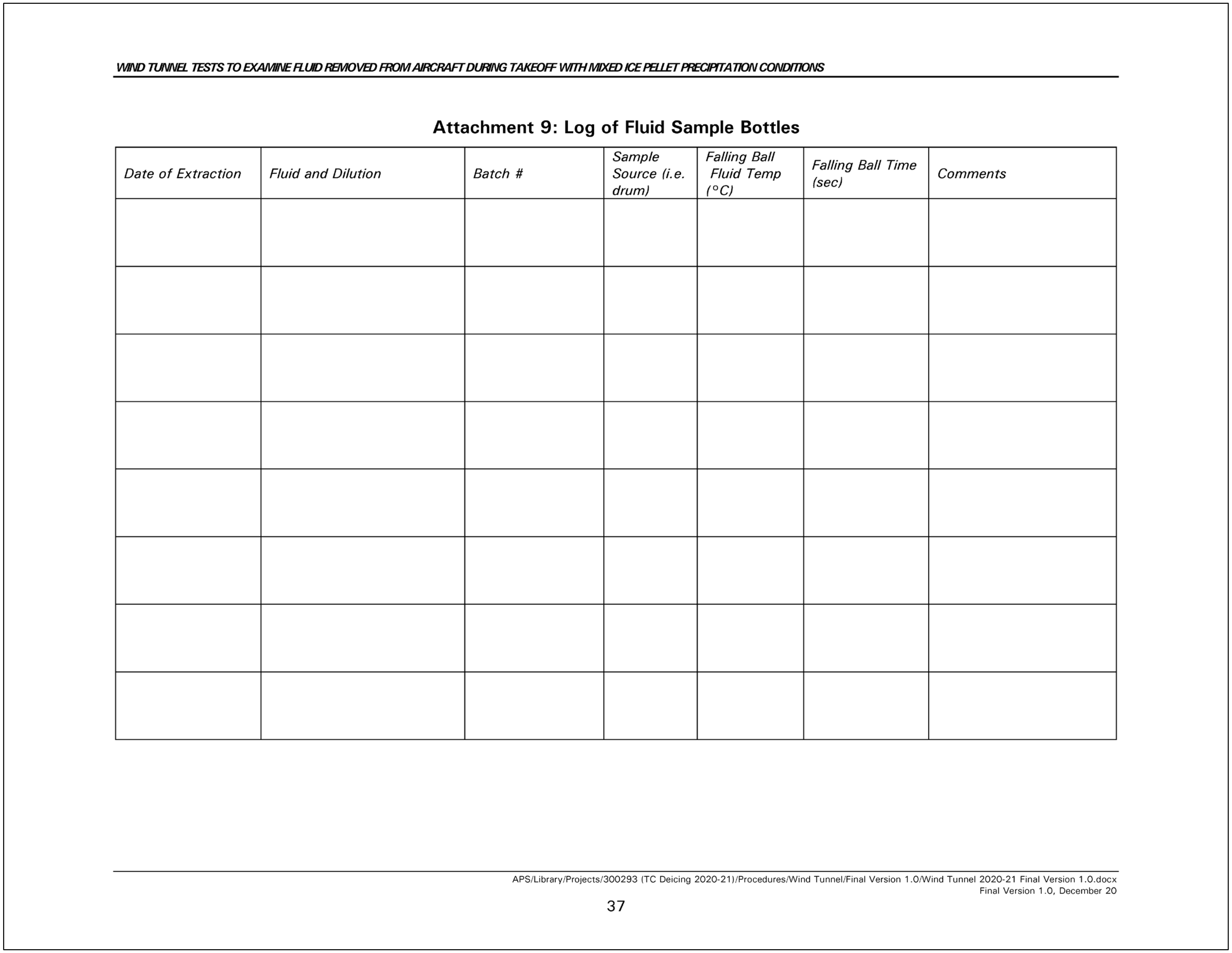


Attachment 9: Log of Fluid Sample Bottles

Date of Extraction	*Fluid and Dilution*	*Batch #*	*Sample Source (i.e. drum)*	*Falling Ball Fluid Temp (°C)*	*Falling Ball Time (sec)*	*Comments*

Attachment 10: Procedure - Dry Wing Performance

Background

A significant amount of work has been done in conjunction with NASA and NRC in order to calibrate and characterize the wind tunnel and airfoil model during the last two winter seasons. This work has further increased the confidence in the data produced, however ongoing verification is necessary in order to identify potential changes in the system performance.

Objective

Verify that clean model aerodynamic data agree with the data acquired in previous years with the same model. Given the various issues with repeatability and angle of attack offsets in the past, this is an important step prior to fluids testing.

Methodology

- Ensure the wing is clean and dry;
- Conduct a dry wing test using the regular takeoff profile;
- Conduct a dry wing test using a takeoff profile with rotation to stall;
- Compare lift performance to historical data; and
- Address potential discrepancies accordingly.

Test Plan

This testing should be conducted at the start of each testing day.

Attachment 11: Procedure – Type IV Ice Pellet Allowance Time Validation with New Fluids

Background

The Type IV ice pellet allowance times are conservative, generic guidance developed based on data collected using commercially available Type IV fluids. As new fluids are developed and become commercially available, it is important to evaluate these fluids against the current allowance times to ensure the validity of the generic guidance. Systematic "spot-checking" is used in order to identify any potential issues. In addition, testing is recommended with all fluids available to obtain data close to the fluid LOUT to determine the aerodynamic effects of ice pellet contamination at these colder temperatures.

Objective

To evaluate newly commercialized Type IV fluids against the existing allowance times, and to collect data close to the fluid LOUT.

Methodology

- Conduct testing with any new commercially available Type IV fluids in each of the cells of the ice pellet allowance times table;
- Record lift data, visual observations, and manually collected data;
- Adjust testing plan accordingly based on aerodynamic data collected; and
- Weather permitting, conduct testing close to the fluid LOUT (-25 to -30°C) with appropriate conditions to address data gaps.

Test Plan

Four days of testing are planned.

Attachment 12: Procedure – Development of EG Specific Ice Pellet Allowance Time Table

Background

Type IV ice pellet allowance times are also intended to be conservative, and therefore generic guidance is developed based on data collected using commercially available Type IV fluids. Historically both Type IV PG and EG fluids have been grouped together, however data has indicated that EG may have an operational advantage of longer ice pellet allowance times in specific conditions. The industry requested that EG specific fluid ice pellet allowance time tables be generated to be able to benefit from any potential linger allowance times specific to Type EG fluids.

Objective

To conduct testing to investigate the feasibility of developing an EG specific ice pellet allowance time table.

Methodology

- Determine what EG data exists and any potential data gaps which need to be filled;
- Conduct testing with commercially available EG Type IV fluids in each of the cells of the ice pellet allowance times table, as required;
- Record lift data, visual observations, and manually collected data; and
- Adjust testing plan accordingly based on aerodynamic data collected.

Test Plan

10 days of testing are planned.

Previous EG Expansion Data for Planning and Reference Purposes

The detailed data for all EG tests conducted since 2009 with the RJ wing has been reviewed. Table B provides a summary of all data points including those tested to the allowance time, as well as those tested to exposure times longer than the current allowance time. Table C includes only the validation tests, hence tests that were run to the current allowance time. Table D includes only the tests that were run longer than the current allowance times, or in conditions where there are no allowance times.

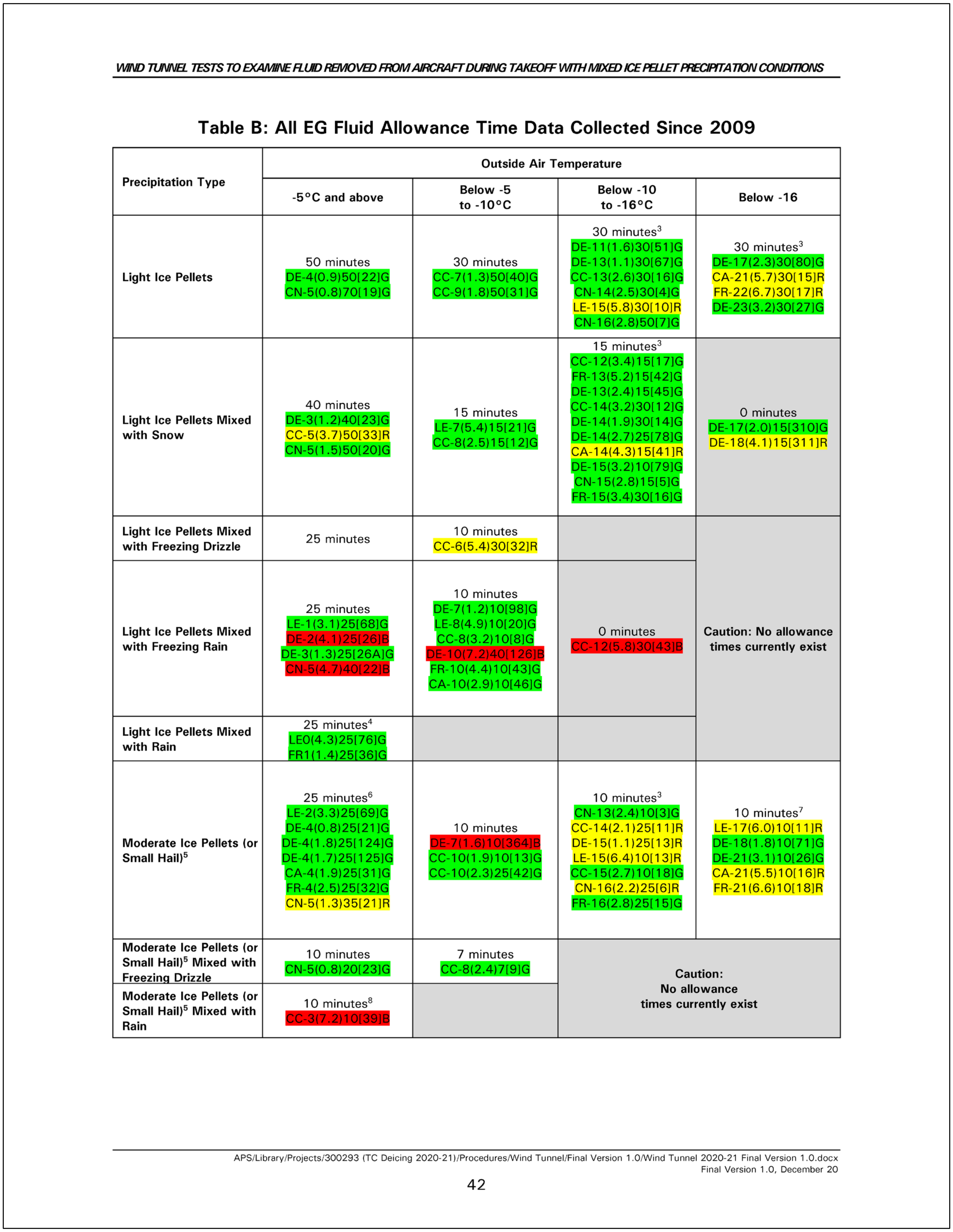
For yellow and red (review or bad) tests, comments were included describing the reason for the rating.

For Table B, Table C, and Table D, the individual test information has been included in the format provided below.

- AABB(CC)DD[EE]F
    - AA is the fluid name designation as listed Table A.
    - BB is the static tunnel air temperature recorded just before the start of the simulated takeoff test, measured in degrees Celsius and rounded to the closest degree.
    - CC is the percent Lift Loss calculated based on the comparison of the 8º lift coefficient during the test run versus the dry wing average lift coefficient.
    - DD is the exposure time of the test in minutes.
    - EE is the test number for reference the data in the test logs.
    - F is the status of the testing, either “G” for Good, “R” for Review, and “B” for Bad, as per the guidelines for evaluating the tests. The highlighting is in a corresponding green, yellow, and red colour.
    - The test information is included in the cell for which the temperature band best corresponds to the temperature recorded during the test.

Table A: Fluid Name Abbreviated Designation for EG Expansion Analysis

Fluid Name	Abbreviation
Chemco ChemR EG IV	CC
Clariant AVIA	CA
Clariant North	CN
EG106	DE
LNT E450	LE
Defrost EG IV	FR



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Table B: All EG Fluid Allowance Time Data Collected Since 2009

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16**
Light Ice Pellets	50 minutes DE-4(0.9)50[22]G CN-5(0.8)70[19]G	30 minutes CC-7(1.3)50[40]G CC-9(1.8)50[31]G	30 minutes[3] DE-11(1.6)30[51]G DE-13(1.1)30[67]G CC-13(2.6)30[16]G CN-14(2.5)30[4]G LE-15(5.8)30[10]R CN-16(2.8)50[7]G	30 minutes[3] DE-17(2.3)30[80]G CA-21(5.7)30[15]R FR-22(6.7)30[17]R DE-23(3.2)30[27]G
Light Ice Pellets Mixed with Snow	40 minutes DE-3(1.2)40[23]G CC-5(3.7)50[33]R CN-5(1.5)50[20]G	15 minutes LE-7(5.4)15[21]G CC-8(2.5)15[12]G	15 minutes[3] CC-12(3.4)15[17]G FR-13(5.2)15[42]G DE-13(2.4)15[45]G CC-14(3.2)30[12]G DE-14(1.9)30[14]G DE-14(2.7)25[78]G CA-14(4.3)15[41]R DE-15(3.2)10[79]G CN-15(2.8)15[5]G FR-15(3.4)30[16]G	0 minutes DE-17(2.0)15[310]G DE-18(4.1)15[311]R
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes CC-6(5.4)30[32]R		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes LE-1(3.1)25[68]G DE-2(4.1)25[26]B DE-3(1.3)25[26A]G CN-5(4.7)40[22]B	10 minutes DE-7(1.2)10[98]G LE-8(4.9)10[20]G CC-8(3.2)10[8]G DE-10(7.2)40[126]B FR-10(4.4)10[43]G CA-10(2.9)10[46]G	0 minutes CC-12(5.8)30[43]B	
Light Ice Pellets Mixed with Rain	25 minutes[4] LE0(4.3)25[76]G FR1(1.4)25[36]G			
Moderate Ice Pellets (or Small Hail)[5]	25 minutes[6] LE-2(3.3)25[69]G DE-4(0.8)25[21]G DE-4(1.8)25[124]G DE-4(1.7)25[125]G CA-4(1.9)25[31]G FR-4(2.5)25[32]G CN-5(1.3)35[21]R	10 minutes DE-7(1.6)10[364]B CC-10(1.9)10[13]G CC-10(2.3)25[42]G	10 minutes[3] CN-13(2.4)10[3]G CC-14(2.1)25[11]R DE-15(1.1)25[13]R LE-15(6.4)10[13]R CC-15(2.7)10[18]G CN-16(2.2)25[6]R FR-16(2.8)25[15]G	10 minutes[7] LE-17(6.0)10[11]R DE-18(1.8)10[71]G DE-21(3.1)10[26]G CA-21(5.5)10[16]R FR-21(6.6)10[18]R
Moderate Ice Pellets (or Small Hail)[5] Mixed with Freezing Drizzle	10 minutes CN-5(0.8)20[23]G	7 minutes CC-8(2.4)7[9]G	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail)[5] Mixed with Rain	10 minutes[8] CC-3(7.2)10[39]B			

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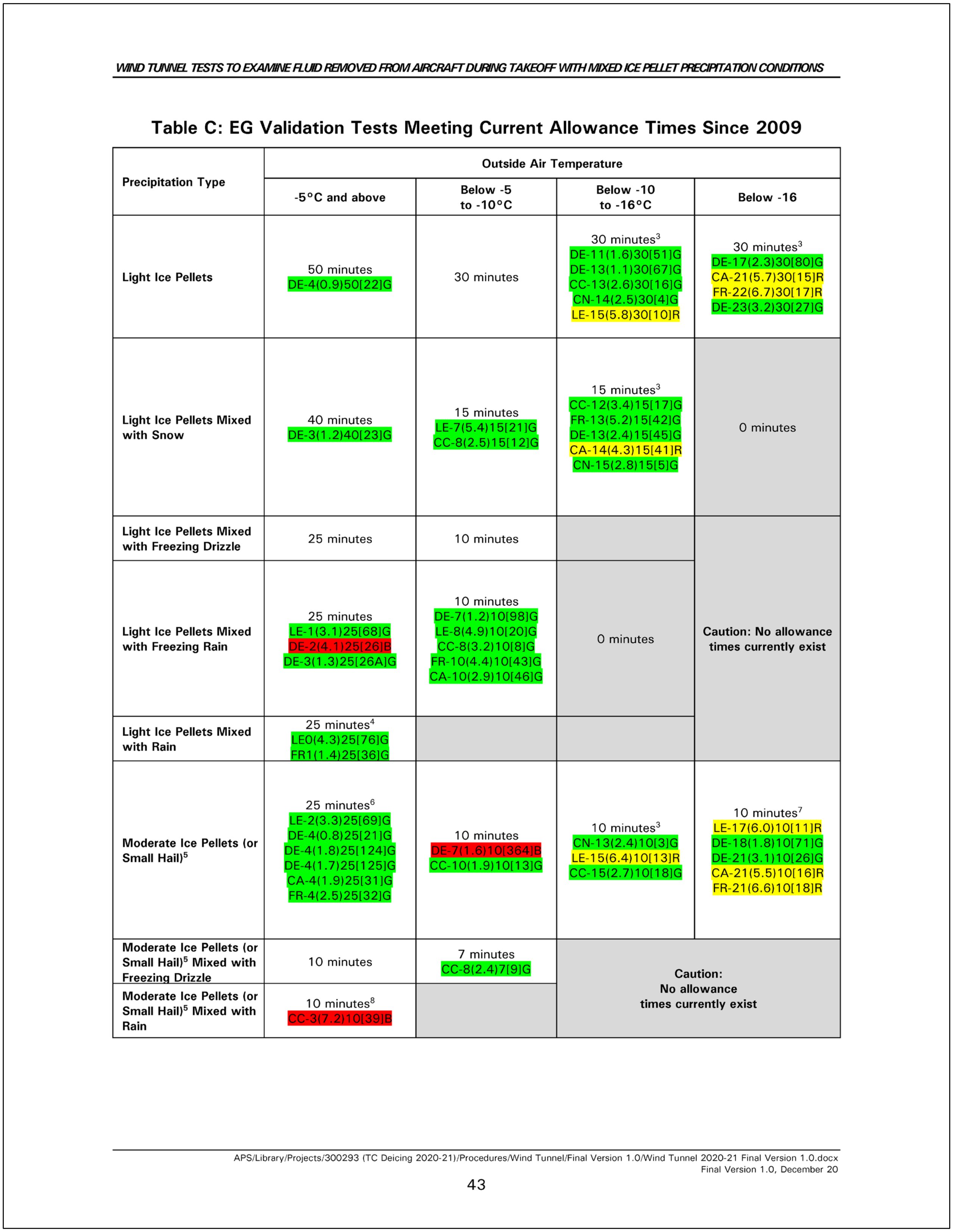
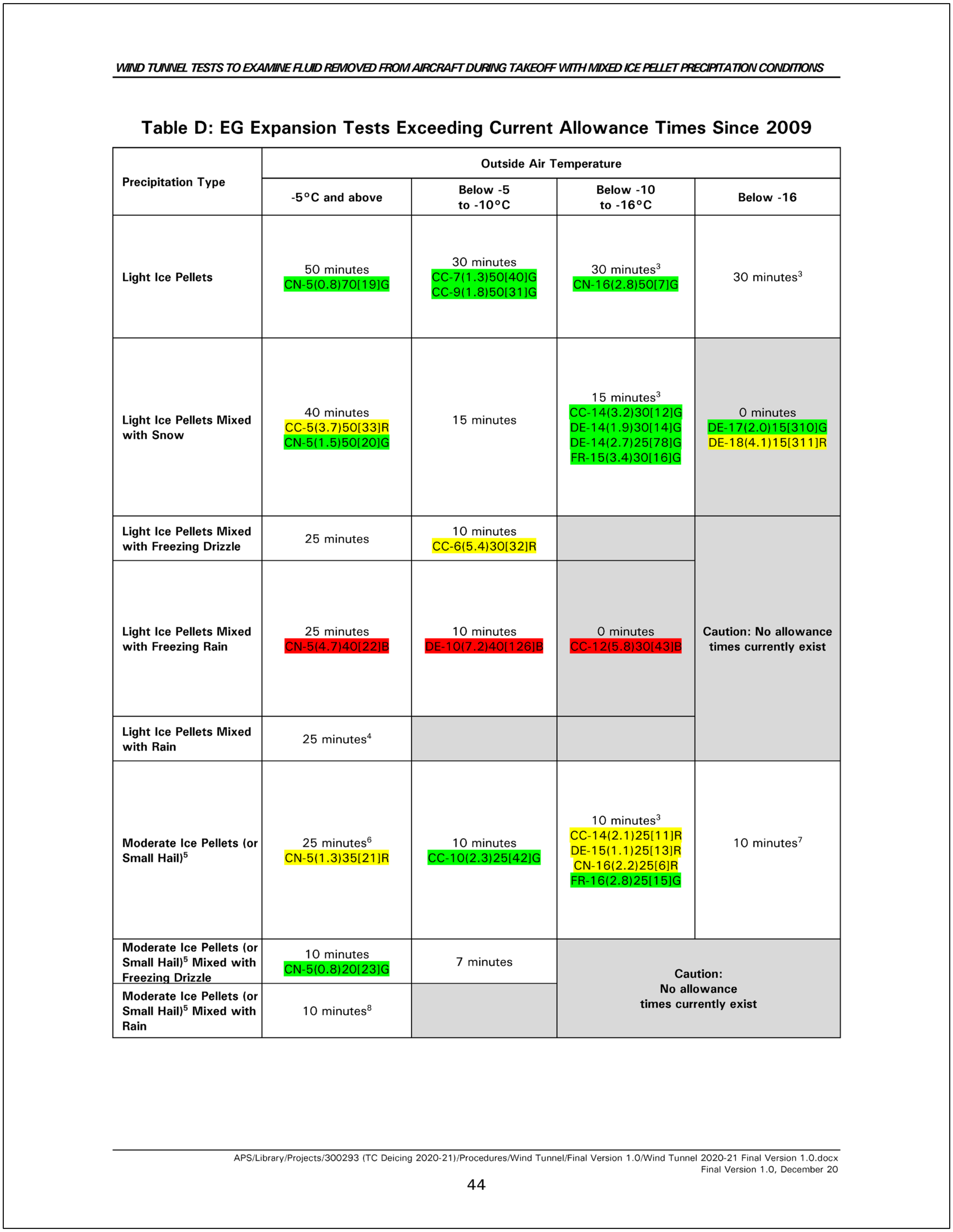


Table C: EG Validation Tests Meeting Current Allowance Times Since 2009

Precipitation Type	**Outside Air Temperature**			
	-5°C and above	**Below -5 to -10°C**	**Below -10 to -16°C**	**Below -16**
Light Ice Pellets	50 minutes DE-4(0.9)50[22]G	30 minutes	30 minutes[3] DE-11(1.6)30[51]G DE-13(1.1)30[67]G CC-13(2.6)30[16]G CN-14(2.5)30[4]G LE-15(5.8)30[10]R	30 minutes[3] DE-17(2.3)30[80]G CA-21(5.7)30[15]R FR-22(6.7)30[17]R DE-23(3.2)30[27]G
Light Ice Pellets Mixed with Snow	40 minutes DE-3(1.2)40[23]G	15 minutes LE-7(5.4)15[21]G CC-8(2.5)15[12]G	15 minutes[3] CC-12(3.4)15[17]G FR-13(5.2)15[42]G DE-13(2.4)15[45]G CA-14(4.3)15[41]R CN-15(2.8)15[5]G	0 minutes
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes LE-1(3.1)25[68]G DE-2(4.1)25[26]B DE-3(1.3)25[26A]G	10 minutes DE-7(1.2)10[98]G LE-8(4.9)10[20]G CC-8(3.2)10[8]G FR-10(4.4)10[43]G CA-10(2.9)10[46]G	0 minutes	
Light Ice Pellets Mixed with Rain	25 minutes[4] LE0(4.3)25[76]G FR1(1.4)25[36]G			
Moderate Ice Pellets (or Small Hail)[5]	25 minutes[6] LE-2(3.3)25[69]G DE-4(0.8)25[21]G DE-4(1.8)25[124]G DE-4(1.7)25[125]G CA-4(1.9)25[31]G FR-4(2.5)25[32]G	10 minutes DE-7(1.6)10[364]B CC-10(1.9)10[13]G	10 minutes[3] CN-13(2.4)10[3]G LE-15(6.4)10[13]R CC-15(2.7)10[18]G	10 minutes[7] LE-17(6.0)10[11]R DE-18(1.8)10[71]G DE-21(3.1)10[26]G CA-21(5.5)10[16]R FR-21(6.6)10[18]R
Moderate Ice Pellets (or Small Hail)[5] Mixed with Freezing Drizzle	10 minutes	7 minutes CC-8(2.4)7[9]G	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail)[5] Mixed with Rain	10 minutes[8] CC-3(7.2)10[39]B			



WIND TUNNEL TESTS TO EXAMINE FLUID REMOVED FROM AIRCRAFT DURING TAKEOFF WITH MIXED ICE PELLET PRECIPITATION CONDITIONS

Table D: EG Expansion Tests Exceeding Current Allowance Times Since 2009

Precipitation Type	Outside Air Temperature			
	-5°C and above	Below -5 to -10°C	Below -10 to -16°C	Below -16
Light Ice Pellets	50 minutes CN-5(0.8)70[19]G	30 minutes CC-7(1.3)50[40]G CC-9(1.8)50[31]G	30 minutes[3] CN-16(2.8)50[7]G	30 minutes[3]
Light Ice Pellets Mixed with Snow	40 minutes CC-5(3.7)50[33]R CN-5(1.5)50[20]G	15 minutes	15 minutes[3] CC-14(3.2)30[12]G DE-14(1.9)30[14]G DE-14(2.7)25[78]G FR-15(3.4)30[16]G	0 minutes DE-17(2.0)15[310]G DE-18(4.1)15[311]R
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes CC-6(5.4)30[32]R		**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Freezing Rain	25 minutes CN-5(4.7)40[22]B	10 minutes DE-10(7.2)40[126]B	0 minutes CC-12(5.8)30[43]B	
Light Ice Pellets Mixed with Rain	25 minutes[4]			
Moderate Ice Pellets (or Small Hail)[5]	25 minutes[6] CN-5(1.3)35[21]R	10 minutes CC-10(2.3)25[42]G	10 minutes[3] CC-14(2.1)25[11]R DE-15(1.1)25[13]R CN-16(2.2)25[6]R FR-16(2.8)25[15]G	10 minutes[7]
Moderate Ice Pellets (or Small Hail)[5] Mixed with Freezing Drizzle	10 minutes CN-5(0.8)20[23]G	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail)[5] Mixed with Rain	10 minutes[8]			

APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Final Version 1.0/Wind Tunnel 2020-21 Final Version 1.0.docx
Final Version 1.0, December 20

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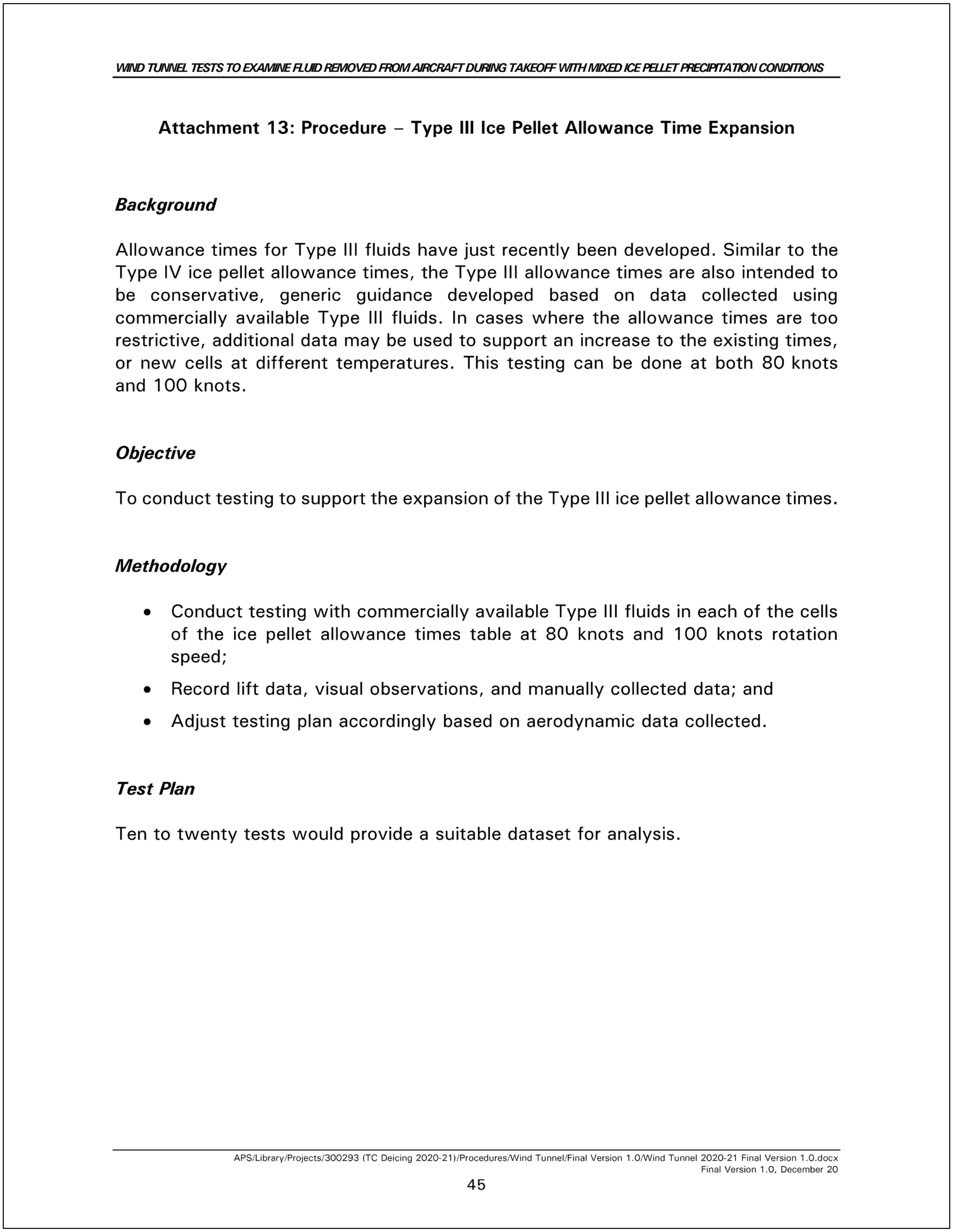


Attachment 13: Procedure – Type III Ice Pellet Allowance Time Expansion

Background

Allowance times for Type III fluids have just recently been developed. Similar to the Type IV ice pellet allowance times, the Type III allowance times are also intended to be conservative, generic guidance developed based on data collected using commercially available Type III fluids. In cases where the allowance times are too restrictive, additional data may be used to support an increase to the existing times, or new cells at different temperatures. This testing can be done at both 80 knots and 100 knots.

Objective

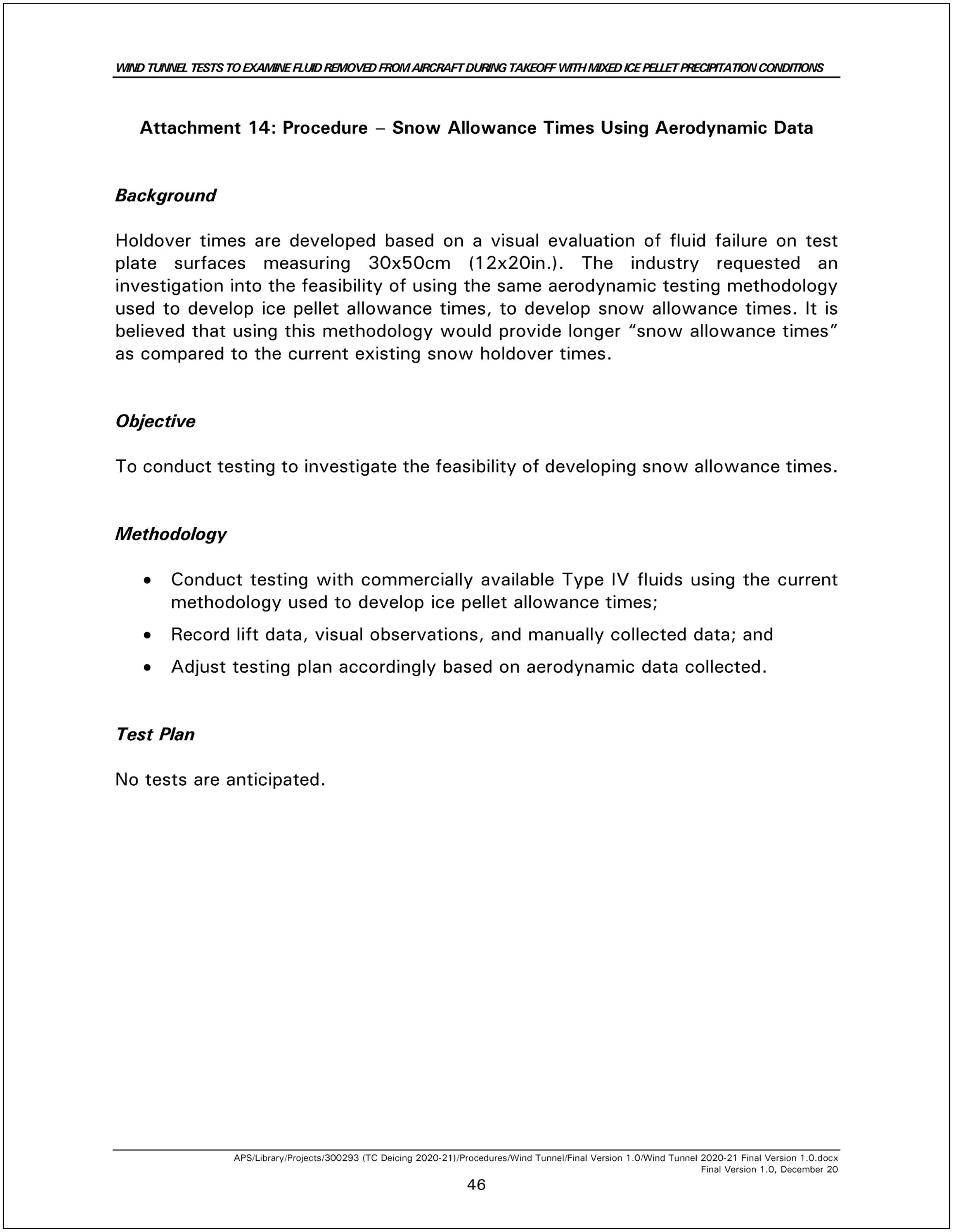
To conduct testing to support the expansion of the Type III ice pellet allowance times.

Methodology

- Conduct testing with commercially available Type III fluids in each of the cells of the ice pellet allowance times table at 80 knots and 100 knots rotation speed;
- Record lift data, visual observations, and manually collected data; and
- Adjust testing plan accordingly based on aerodynamic data collected.

Test Plan

Ten to twenty tests would provide a suitable dataset for analysis.



Attachment 14: Procedure – Snow Allowance Times Using Aerodynamic Data

Background

Holdover times are developed based on a visual evaluation of fluid failure on test plate surfaces measuring 30x50cm (12x20in.). The industry requested an investigation into the feasibility of using the same aerodynamic testing methodology used to develop ice pellet allowance times, to develop snow allowance times. It is believed that using this methodology would provide longer “snow allowance times” as compared to the current existing snow holdover times.

Objective

To conduct testing to investigate the feasibility of developing snow allowance times.

Methodology

- Conduct testing with commercially available Type IV fluids using the current methodology used to develop ice pellet allowance times;
- Record lift data, visual observations, and manually collected data; and
- Adjust testing plan accordingly based on aerodynamic data collected.

Test Plan

No tests are anticipated.

Attachment 15: Procedure - Heavy Snow

Background

As a direct result of the ice pellet research conducted, the use of HOTs for determining the protection time provided by anti-icing fluids was questioned. The focus has turned towards "aerodynamic failure" which can be defined as a significant lift loss resulting from contaminated anti-icing fluid. Heavy snow conditions have been selected for this study for two reasons. First, snow conditions account for the most significant portion of deicing operations globally. Secondly, there has been a recent industry interest for holdover time for heavy snow conditions. Preliminary aerodynamic testing was conducted during the winters of 2006-07 and 2008-2011.

Objective

To investigate the fluid aerodynamic flow-off characteristics of anti-icing fluid contaminated with simulated heavy snow versus moderate snow.

Methodology

The general methodology to be used during these tests is in accordance with the methodologies used for typical snow condition tests conducted in the wind tunnel.

- For a chosen fluid, conduct a test simulating moderate snow conditions (rate of 25 $g/dm^2/h$) for an exposure time derived from the HOT table based on the tunnel temperature at the time of the test;
- Record lift data, visual observations, and manually collected data;
- Conduct two comparative tests simulating heavy snow conditions (rate of 50 $g/dm^2/h$ or higher) for the same exposure time used during the moderate snow test;

  NOTE: Previous testing has indicated that using half, to ¾ of the moderate snow HOT generates similar end conditions; whereas using the full moderate HOT for heavy snow conditions generates a more sever fluid failure which behaves worse aerodynamically.
- Record lift data, visual observations, and manually collected data;
- Compare the heavy snow results to the moderate snow results. If the heavy snow results are worse, repeat the heavy snow test with a reduced exposure time, if the results are better, repeat the heavy snow test with an increased exposure time;

- Repeat until similar lift data, and visual observations are achieved for both heavy snow and moderate snow; and
- Document the percentage of the moderate snow HOT that is acceptable for heavy snow conditions.

Test Plan

Two to four comparative tests would provide a suitable dataset for analysis. See previous reports for suggested test plan.

Attachment 16: Procedure - Heavy Contamination

Background

Previous testing in the wind tunnel demonstrated that although very heavy ice pellet and/or snow contamination was applied to a fluid covered wing section, significant lift losses were not apparent. The initial testing indicated that after a certain level of contamination, the dry loose ice pellets or snow no longer absorb into the fluid and easily fly off during the acceleration. The protection is due to a thin layer of fluid present underneath the contamination that prevents adherence. Questions of which point the lift losses become detrimental have been raised.

Objective

To continue previous research investigating heavy contamination effects on fluid flow-off.

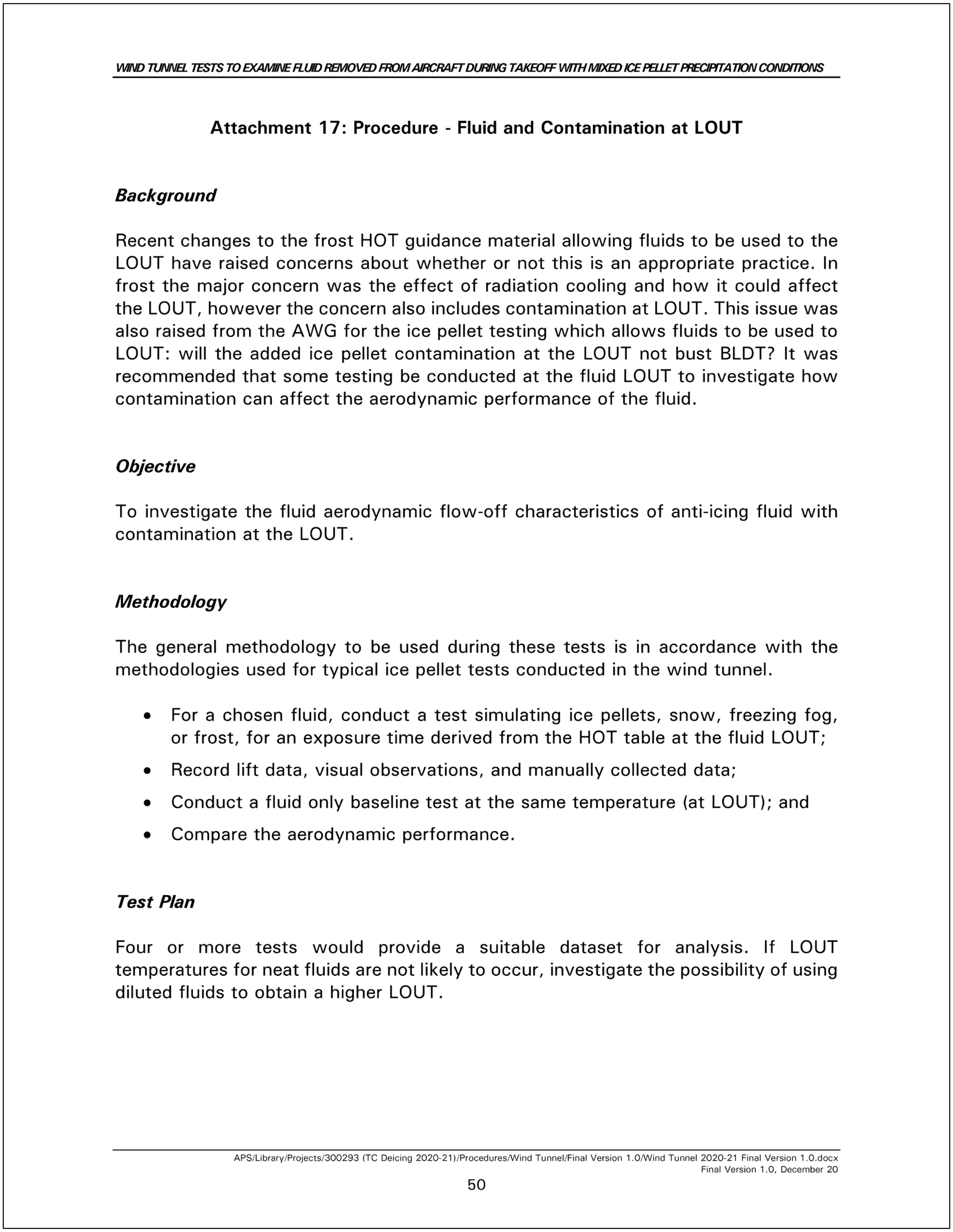
Methodology

The general methodology to be used during these tests is in accordance with the methodologies used for typical ice pellet tests conducted in the wind tunnel.

- For a chosen fluid, conduct a test simulating ice pellets, snow, or freezing rain, for an exposure time far exceeding the recommended HOT or allowance time;
- Record lift data, visual observations, and manually collected data; and
- Compare aerodynamic performance results to fluid only or fluid and contamination tests at the same temperature.

Test Plan

One to four tests would provide a suitable dataset for analysis. Previous work should be referenced to identify starting levels of heavy contamination.



Attachment 17: Procedure - Fluid and Contamination at LOUT

Background

Recent changes to the frost HOT guidance material allowing fluids to be used to the LOUT have raised concerns about whether or not this is an appropriate practice. In frost the major concern was the effect of radiation cooling and how it could affect the LOUT, however the concern also includes contamination at LOUT. This issue was also raised from the AWG for the ice pellet testing which allows fluids to be used to LOUT: will the added ice pellet contamination at the LOUT not bust BLDT? It was recommended that some testing be conducted at the fluid LOUT to investigate how contamination can affect the aerodynamic performance of the fluid.

Objective

To investigate the fluid aerodynamic flow-off characteristics of anti-icing fluid with contamination at the LOUT.

Methodology

The general methodology to be used during these tests is in accordance with the methodologies used for typical ice pellet tests conducted in the wind tunnel.

- For a chosen fluid, conduct a test simulating ice pellets, snow, freezing fog, or frost, for an exposure time derived from the HOT table at the fluid LOUT;
- Record lift data, visual observations, and manually collected data;
- Conduct a fluid only baseline test at the same temperature (at LOUT); and
- Compare the aerodynamic performance.

Test Plan

Four or more tests would provide a suitable dataset for analysis. If LOUT temperatures for neat fluids are not likely to occur, investigate the possibility of using diluted fluids to obtain a higher LOUT.

Attachment 18: Procedure - Frost Simulation in the Wind Tunnel

Background

Frost is an important consideration in aircraft deicing. The irregular and rough frost accretion patterns can result in a significant loss of lift on critical aircraft surfaces. This potential hazard is amplified by the frequent occurrence of frost accretion in winter operations. Frost is an area of research that has yet to be fully explored. Discussions regarding the aerodynamic effects of frost have been raised, and the possibility of doing wind tunnel testing has been considered. It was recommended that initial testing be performed to investigate whether it would be feasible to simulate frost conditions in the PIWT.

Objective

To investigate the feasibility of simulating frost conditions in the PIWT.

Methodology

This work is exploratory, so no exact procedure exists. It is recommended that the frost generating parameters be explored to try and stimulate frost accretion. This can be done by causing a negative temperature differential between the wing and the ambient air i.e. air is warmer than skin. A more specific methodology may be determined on site following a brain-storm with on-site technicians.

Test Plan

One or two tests would provide a suitable dataset for analysis.

Attachment 19: Procedure - Feasibility of Ice Pellet Testing at Higher Speeds

Background

Historically, the ice pellet allowance time testing conducted in the wind tunnel simulated typical aircraft rotation of 100 knots, and more recently some limited work at 115 knots. As a result of some of the higher lift losses observed at colder temperatures with PG fluids applied to a thin high performance airfoil, it was recommended that higher speed testing be conducted to verify if the limitations in the allowance times would need to be applied to commercial aircraft with rotation speeds well above 115 knots. It was recommended that 130-150 knots be targeted, however modifications to the wind tunnel may be required as those higher speeds may increase stress on the wind tunnel engine and other structural systems.

Objective

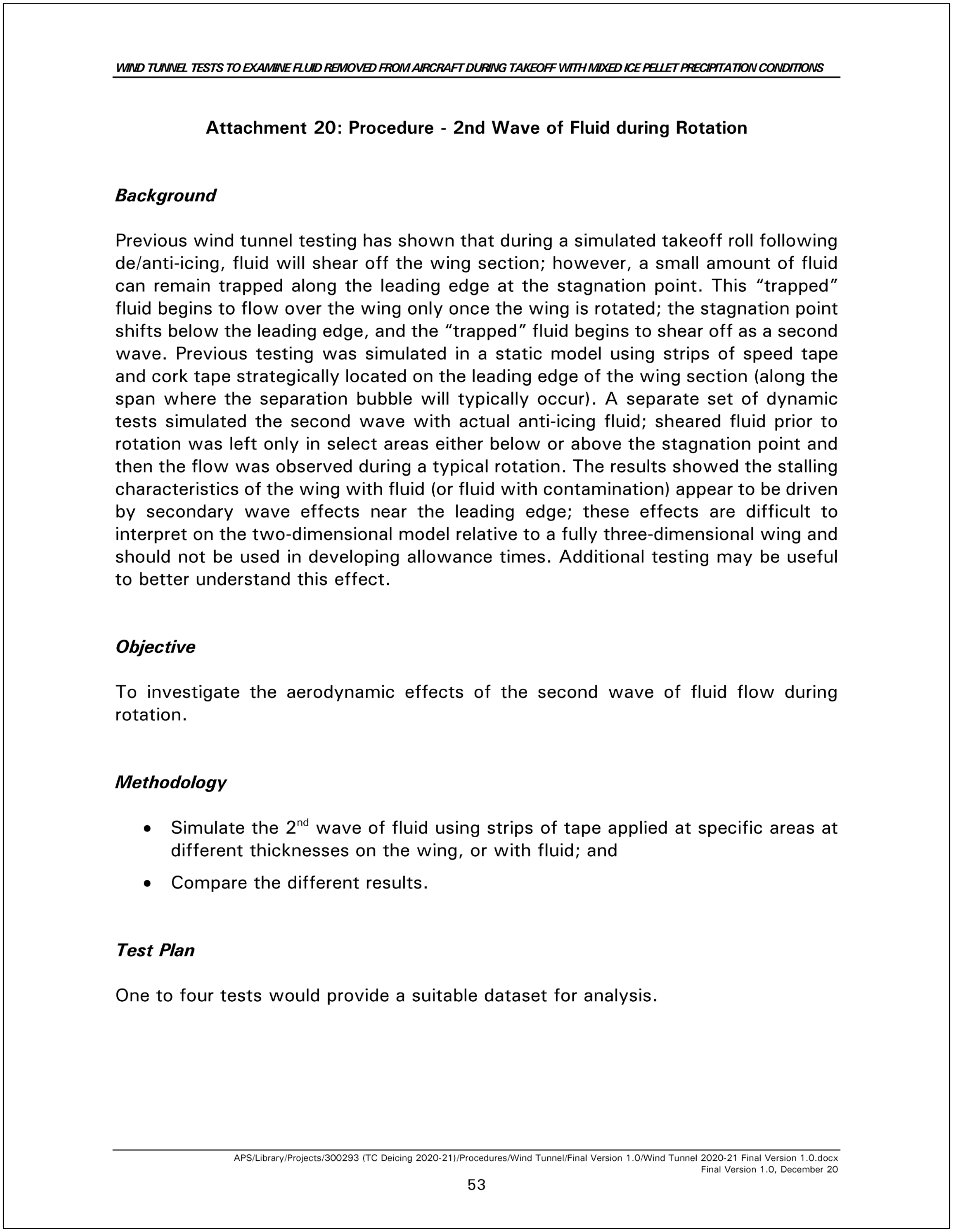
To investigate the feasibility of conducting ice pellet testing at higher speeds of 130-150 knots.

Methodology

This work is exploratory, so no exact procedure exists. A more specific methodology may be determined on site following a brain-storm with on-site technicians. It is expected that a series of tests may be conducted to try and achieve speeds above 115 knots without rotating the wing model.

Test Plan

One or two tests would provide a suitable dataset for analysis, however more tests may be required based on the results.



Attachment 20: Procedure - 2nd Wave of Fluid during Rotation

Background

Previous wind tunnel testing has shown that during a simulated takeoff roll following de/anti-icing, fluid will shear off the wing section; however, a small amount of fluid can remain trapped along the leading edge at the stagnation point. This “trapped” fluid begins to flow over the wing only once the wing is rotated; the stagnation point shifts below the leading edge, and the “trapped” fluid begins to shear off as a second wave. Previous testing was simulated in a static model using strips of speed tape and cork tape strategically located on the leading edge of the wing section (along the span where the separation bubble will typically occur). A separate set of dynamic tests simulated the second wave with actual anti-icing fluid; sheared fluid prior to rotation was left only in select areas either below or above the stagnation point and then the flow was observed during a typical rotation. The results showed the stalling characteristics of the wing with fluid (or fluid with contamination) appear to be driven by secondary wave effects near the leading edge; these effects are difficult to interpret on the two-dimensional model relative to a fully three-dimensional wing and should not be used in developing allowance times. Additional testing may be useful to better understand this effect.

Objective

To investigate the aerodynamic effects of the second wave of fluid flow during rotation.

Methodology

- Simulate the 2nd wave of fluid using strips of tape applied at specific areas at different thicknesses on the wing, or with fluid; and
- Compare the different results.

Test Plan

One to four tests would provide a suitable dataset for analysis.

Attachment 21: Procedure – V-Stab Testing

Background

The IWT provided an effective means to carry out vertical stabilizer research accommodating the installation of an appropriate size model and allowing the application of fluids. The objective is to have agreement on a common research model (with the support of the AWG) by end of 2020 and so that APS and NRC, under contract to TC and FAA, can begin the construction in 2021 and allow for testing in the winter of 2021-22.

Objective

To study the clean and contaminated fluid flow off from a vertical stabilizer model.

Methodology

- TBD

Test Plan

TBD

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APPENDIX C

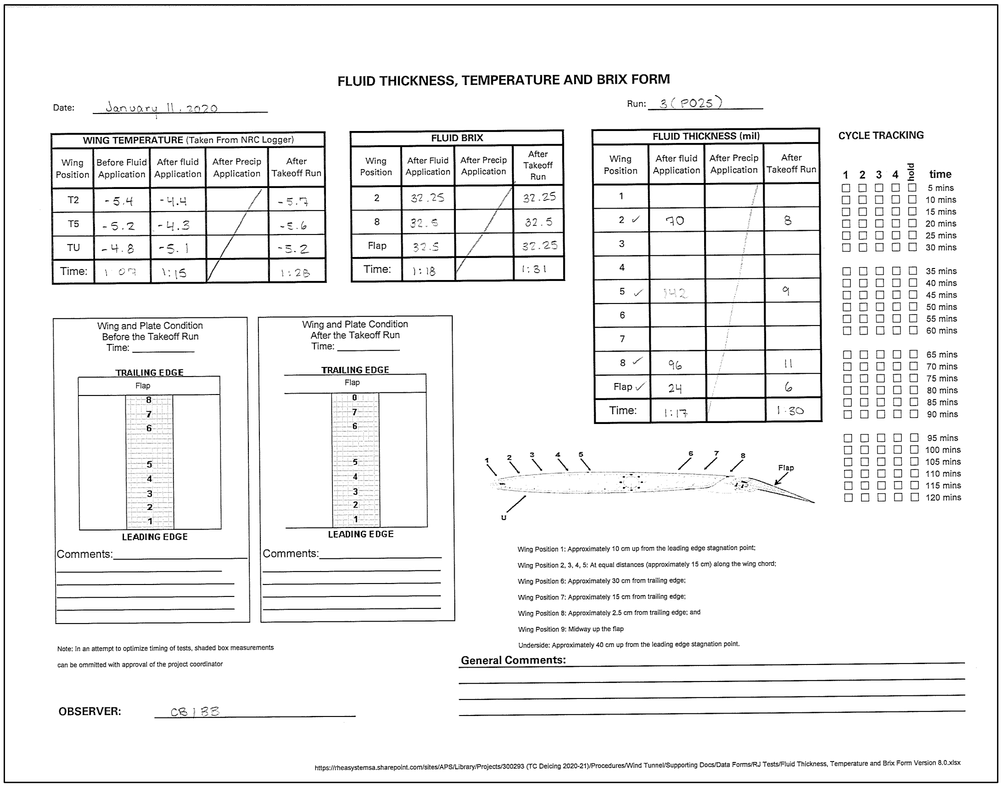
HIGH SPEED TESTING 2020-21 FLUID THICKNESS, TEMPERATURE, AND BRIX DATA FORMS

No Data Available

Figure C1: Run # 1

No Data Available

Figure C2: Run # 2



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2020

Run: 3 (P025)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.4	-4.4		-5.7
T5	-5.2	-4.3		-5.6
TU	-4.8	-5.1		-5.2
Time:	1:07	1:15		1:28

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.25		32.25
8	32.5		32.5
Flap	32.5		32.25
Time:	1:18		1:31

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2 ✓	70		8
3			
4			
5 ✓	142		9
6			
7			
8 ✓	96		11
Flap ✓	24		6
Time:	1:17		1:30

CYCLE TRACKING

1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________

1 2 3 4 5 6 7 8 Flap U

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

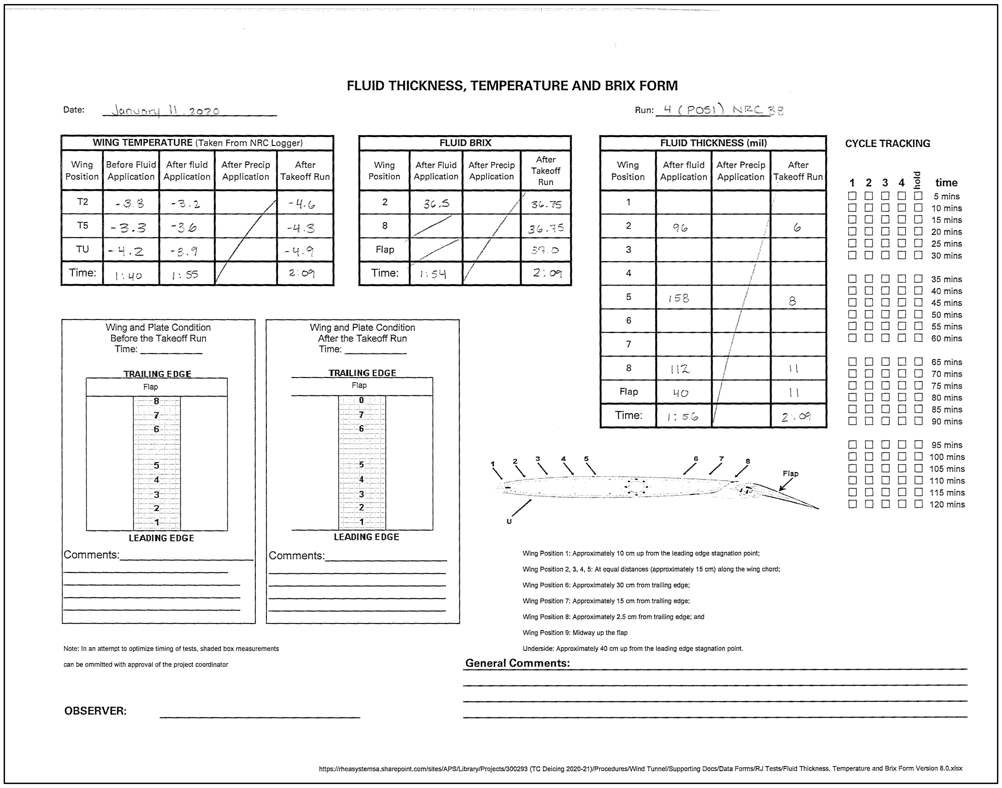
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:___________

OBSERVER: CB 133

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C3: Run # 3



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2020

Run: 4 (P051) NRC 38

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.8	-3.2		-4.6
T5	-3.3	-3.6		-4.3
TU	-4.2	-3.9		-4.9
Time:	1:40	1:55		2:09

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5		36.75
8			36.75
Flap			37.0
Time:	1:54		2:09

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96		6
3			
4			
5	158		8
6			
7			
8	112		11
Flap	40		11
Time:	1:56		2:09

CYCLE TRACKING

1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________

1 2 3 4 5 6 7 8 Flap U

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

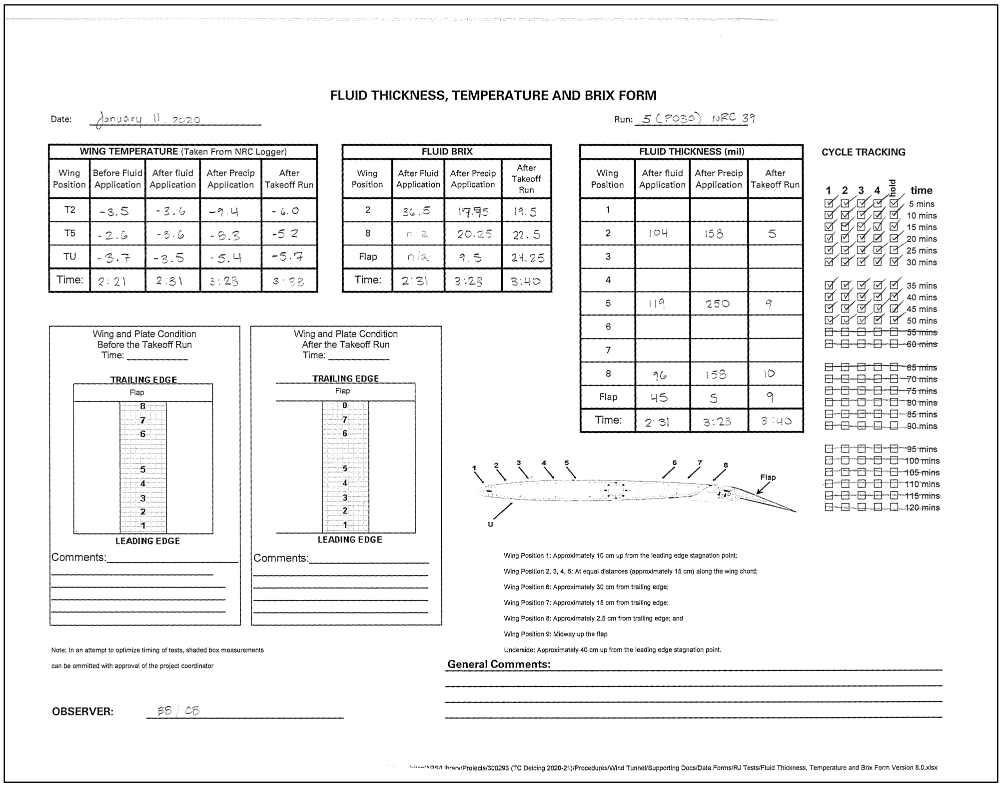
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:___________

OBSERVER: ___________

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C4: Run # 4



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2020

Run: 5 (P030) NRC 39

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.5	-3.6	-9.4	-6.0
T5	-2.6	-3.6	-8.3	-5.2
TU	-3.7	-3.5	-5.4	-5.7
Time:	2:21	2:31	3:28	3:38

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	17.95	19.5
8	n/a	20.25	22.5
Flap	n/a	9.5	24.25
Time:	2:31	3:28	3:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	158	5
3			
4			
5	119	250	9
6			
7			
8	96	158	10
Flap	45	5	9
Time:	2:31	3:28	3:40

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☐	☐	☐	☐	☐	~~55 mins~~
☐	☐	☐	☐	☐	~~60 mins~~
☐	☐	☐	☐	☐	~~65 mins~~
☐	☐	☐	☐	☐	~~70 mins~~
☐	☐	☐	☐	☐	~~75 mins~~
☐	☐	☐	☐	☐	~~80 mins~~
☐	☐	☐	☐	☐	~~85 mins~~
☐	☐	☐	☐	☐	~~90 mins~~
☐	☐	☐	☐	☐	~~95 mins~~
☐	☐	☐	☐	☐	~~100 mins~~
☐	☐	☐	☐	☐	~~105 mins~~
☐	☐	☐	☐	☐	~~110 mins~~
☐	☐	☐	☐	☐	~~115 mins~~
☐	☐	☐	☐	☐	~~120 mins~~

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

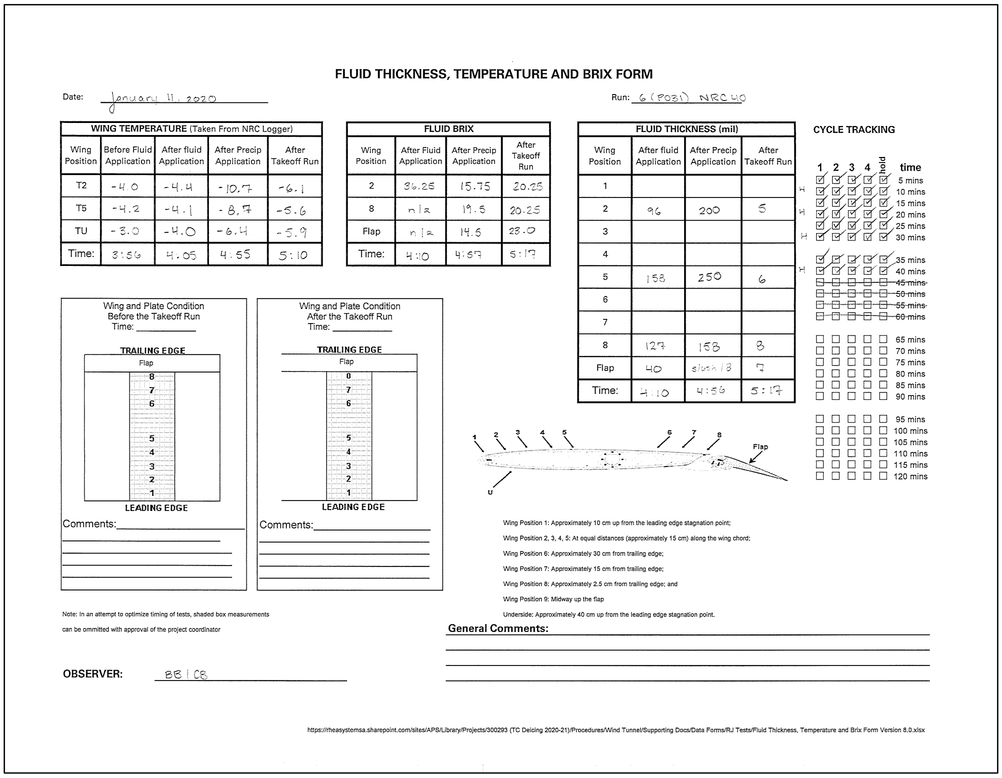
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C5: Run # 5



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2020

Run: 6 (P031) NRC 40

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.0	-4.4	-10.7	-6.1
T5	-4.2	-4.1	-8.7	-5.6
TU	-3.0	-4.0	-6.4	-5.9
Time:	3:56	4:05	4:55	5:10

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	15.75	20.25
8	n/a	19.5	20.25
Flap	n/a	14.5	23.0
Time:	4:10	4:57	5:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	200	5
3			
4			
5	158	250	6
6			
7			
8	127	158	8
Flap	40	slush 18	7
Time:	4:10	4:56	5:17

CYCLE TRACKING

	1	2	3	4	hold	time
	☑	☑	☑	☑	☑	5 mins
H	☑	☑	☑	☑	☑	10 mins
	☑	☑	☑	☑	☑	15 mins
H	☑	☑	☑	☑	☑	20 mins
	☑	☑	☑	☑	☑	25 mins
H	☑	☑	☑	☑	☑	30 mins
	☑	☑	☑	☑	☑	35 mins
H	☑	☑	☑	☑	☑	40 mins
	☐	☐	☐	☐	☐	~~45 mins~~
	☐	☐	☐	☐	☐	~~50 mins~~
	☐	☐	☐	☐	☐	~~55 mins~~
	☐	☐	☐	☐	☐	~~60 mins~~
	☐	☐	☐	☐	☐	65 mins
	☐	☐	☐	☐	☐	70 mins
	☐	☐	☐	☐	☐	75 mins
	☐	☐	☐	☐	☐	80 mins
	☐	☐	☐	☐	☐	85 mins
	☐	☐	☐	☐	☐	90 mins
	☐	☐	☐	☐	☐	95 mins
	☐	☐	☐	☐	☐	100 mins
	☐	☐	☐	☐	☐	105 mins
	☐	☐	☐	☐	☐	110 mins
	☐	☐	☐	☐	☐	115 mins
	☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

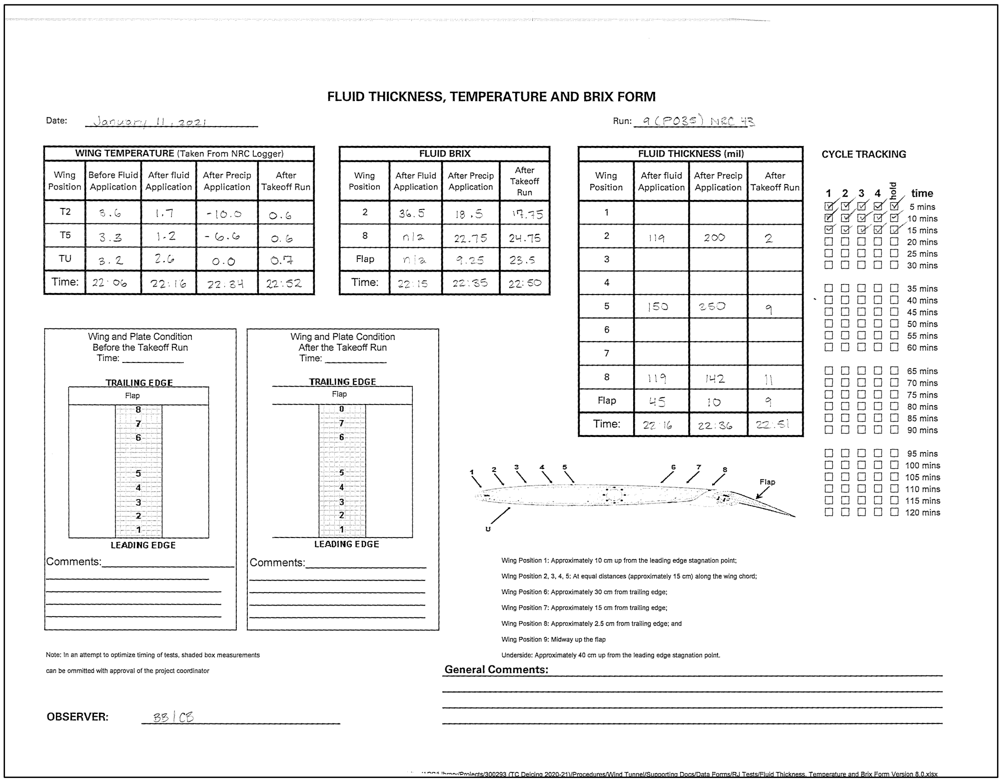
Figure C6: Run # 6

No Data Available

Figure C7: Run # 7

No Data Available

Figure C8: Run # 8



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2021

Run: 9 (P035) NRC 43

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	3.6	1.7	-10.0	0.6
T5	3.3	1.2	-6.6	0.6
TU	3.2	2.6	0.0	0.7
Time:	22:06	22:16	22:34	22:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	18.5	17.75
8	n/a	22.75	24.75
Flap	n/a	9.25	23.5
Time:	22:15	22:35	22:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	200	2
3			
4			
5	150	250	9
6			
7			
8	119	142	11
Flap	45	10	9
Time:	22:16	22:36	22:51

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
0
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

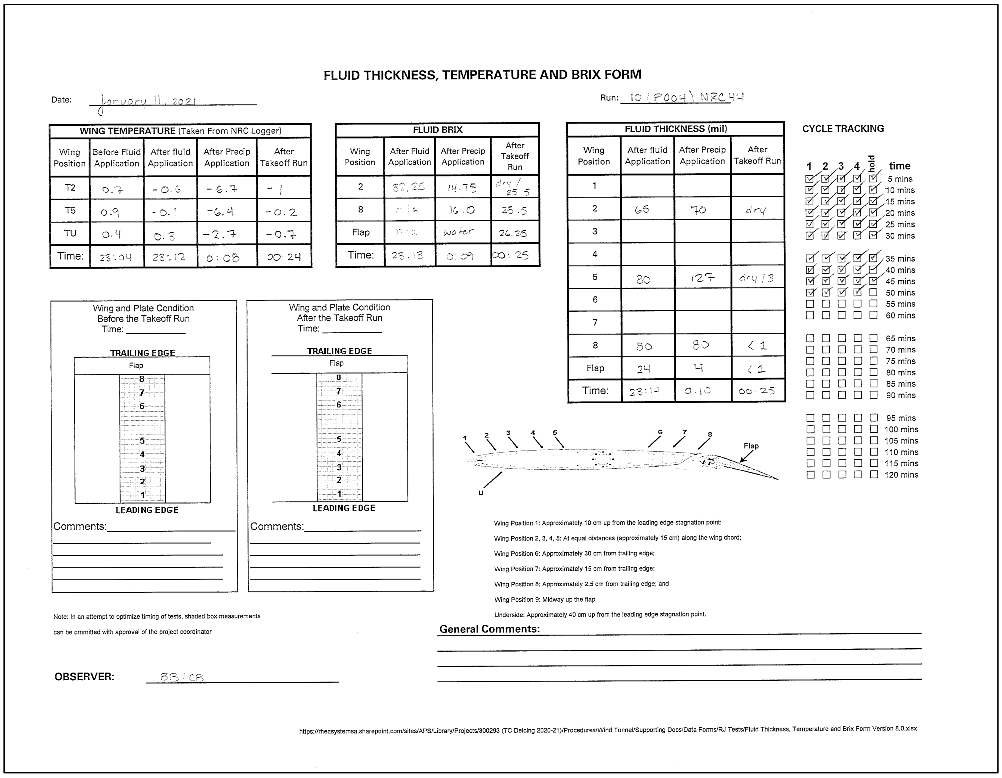
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:____________________

OBSERVER: BB / CB

/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C9: Run # 9



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2021

Run: 10 (P004) NRC44

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.7	-0.6	-6.7	-1
T5	0.9	-0.1	-6.4	-0.2
TU	0.4	0.3	-2.7	-0.7
Time:	23:04	23:12	0:08	00:24

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.25	14.75	dry / 25.5
8	n/a	16.0	25.5
Flap	n/a	water	26.25
Time:	23:13	0:09	00:25

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	70	dry
3			
4			
5	80	127	dry / 3
6			
7			
8	80	80	< 1
Flap	24	4	< 1
Time:	23:14	0:10	00:25

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
0
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:____________________

OBSERVER: BB / CB

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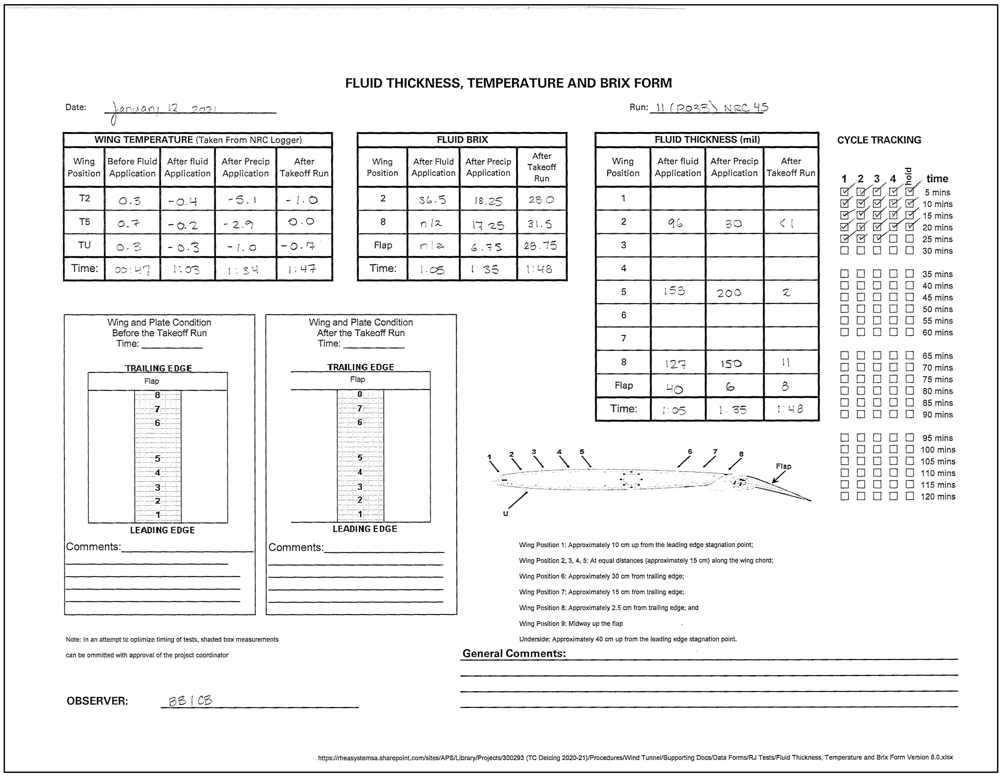
Figure C10: Run # 10



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12 2021

Run: 11 (P033) NRC 45

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.3	-0.4	-5.1	-1.0
T5	0.7	-0.2	-2.9	0.0
TU	0.3	-0.3	-1.0	-0.7
Time:	00:47	1:03	1:34	1:47

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	18.25	28.0
8	n/a	17.25	31.5
Flap	n/a	6.75	28.75
Time:	1.05	1:35	1:48

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	30	<1
3			
4			
5	158	200	2
6			
7			
8	127	150	11
Flap	40	6	8
Time:	1:05	1:35	1:48

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing and Plate Condition After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
0 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB | CB

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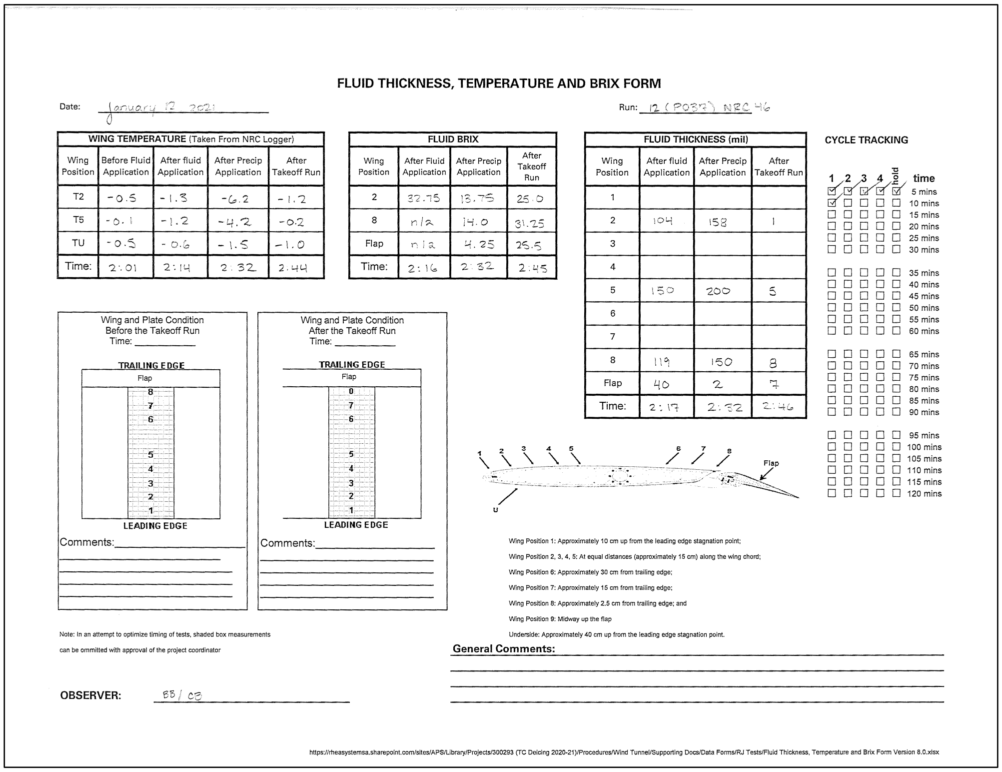
Figure C11: Run # 11



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12 2021

Run: 12 (P037) NRC 46

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.5	-1.3	-6.2	-1.2
T5	-0.1	-1.2	-4.2	-0.2
TU	-0.5	-0.6	-1.5	-1.0
Time:	2:01	2:14	2:32	2.44

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	13.75	25.0
8	n/a	14.0	31.25
Flap	n/a	4.25	25.5
Time:	2:16	2:32	2:45

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	158	1
3			
4			
5	150	200	5
6			
7			
8	119	150	8
Flap	40	2	7
Time:	2:17	2:32	2:46

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing and Plate Condition After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
0 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

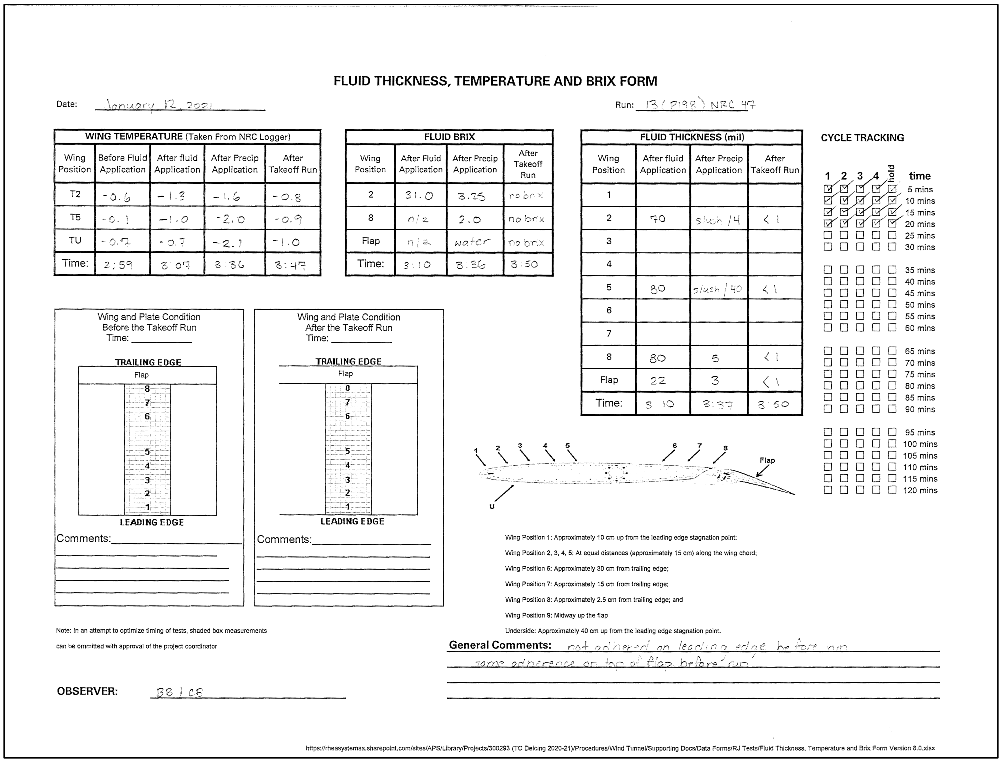
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C12: Run # 12



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2021

Run: 13 (P198) NRC 47

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.6	-1.3	-1.6	-0.8
T5	-0.1	-1.0	-2.0	-0.9
TU	-0.7	-0.7	-2.1	-1.0
Time:	2:59	3:07	3:36	3:47

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	31.0	3.25	no brix
8	n/a	2.0	no brix
Flap	n/a	water	no brix
Time:	3:10	3:36	3:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	slush / 4	< 1
3			
4			
5	80	slush / 40	< 1
6			
7			
8	80	5	< 1
Flap	22	3	< 1
Time:	3:10	3:37	3:50

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: not adhered on leading edge before run
some adherence on top of flap before run

OBSERVER: BB / CB

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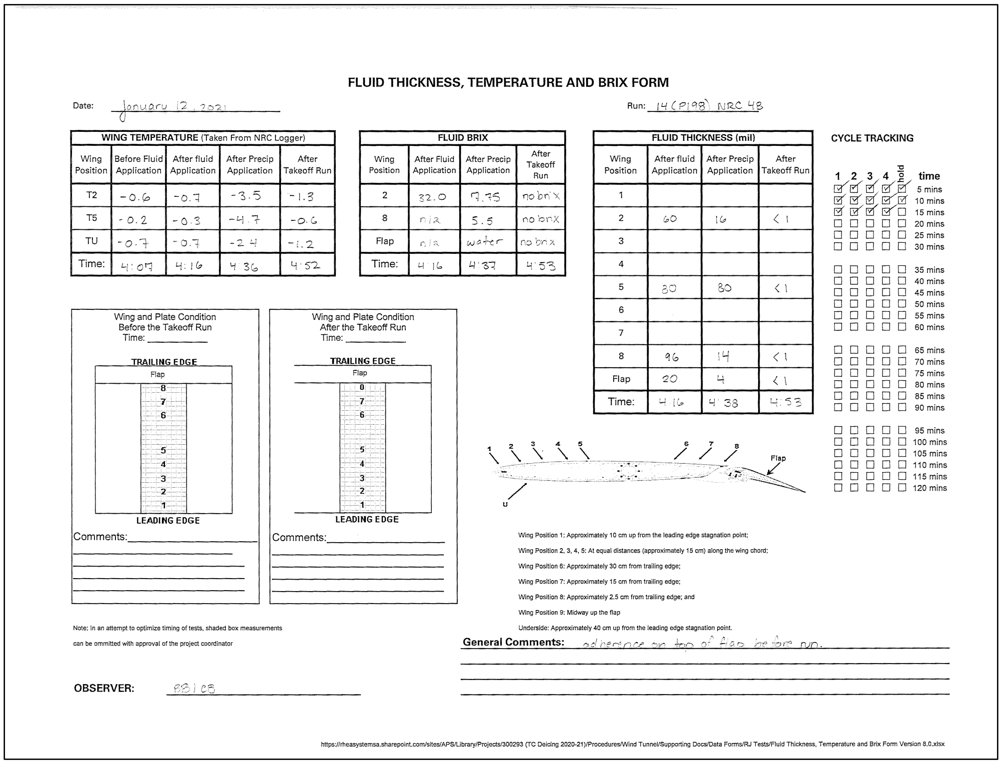
Figure C13: Run # 13



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2021

Run: 14 (P198) NRC 48

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.6	-0.7	-3.5	-1.3
T5	-0.2	-0.3	-4.7	-0.6
TU	-0.7	-0.7	-2.4	-1.2
Time:	4:07	4:16	4:36	4:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.0	7.75	no brix
8	n/a	5.5	no brix
Flap	n/a	water	no brix
Time:	4:16	4:37	4:53

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	16	< 1
3			
4			
5	80	80	< 1
6			
7			
8	96	14	< 1
Flap	20	4	< 1
Time:	4:16	4:38	4:53

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: adherence on top of flap before run.

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

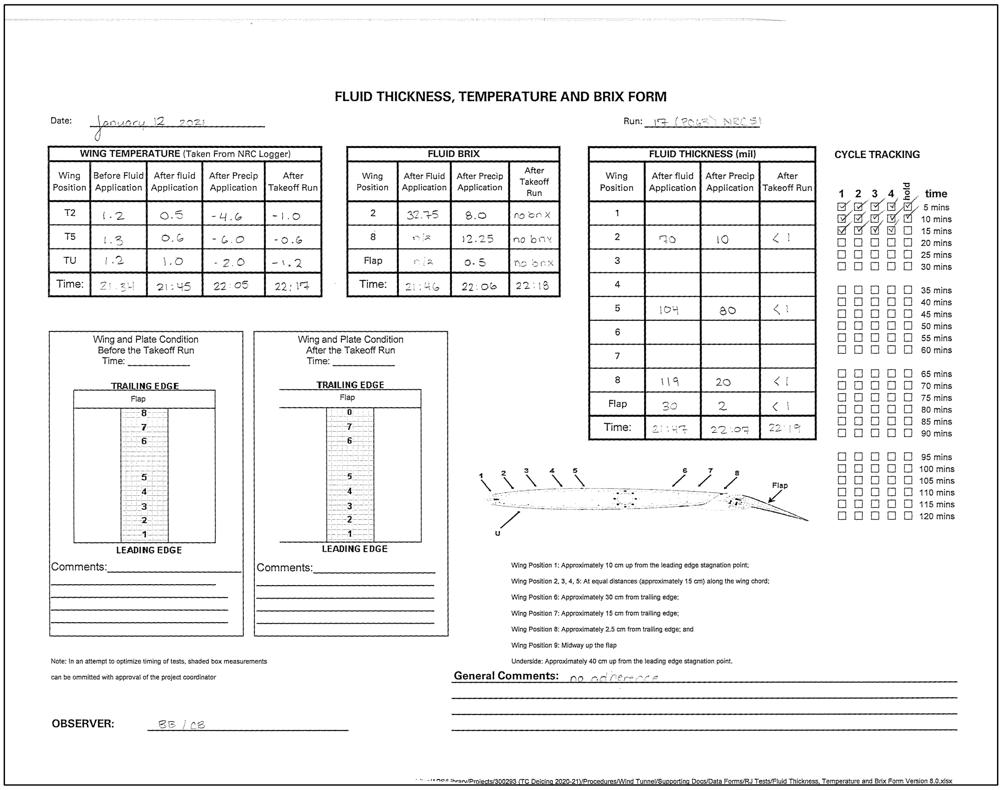
Figure C14: Run # 14

No Data Available

Figure C15: Run # 15

No Data Available

Figure C16: Run # 16



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12 2021

Run: 17 (P063) NRC 51

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	1.2	0.5	-4.6	-1.0
T5	1.3	0.6	-6.0	-0.6
TU	1.2	1.0	-2.0	-1.2
Time:	21:34	21:45	22:05	22:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	8.0	no brix
8	n/a	12.25	no brix
Flap	n/a	0.5	no brix
Time:	21:46	22:06	22:18

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	10	< 1
3			
4			
5	104	80	< 1
6			
7			
8	119	20	< 1
Flap	30	2	< 1
Time:	21:47	22:07	22:19

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
0
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

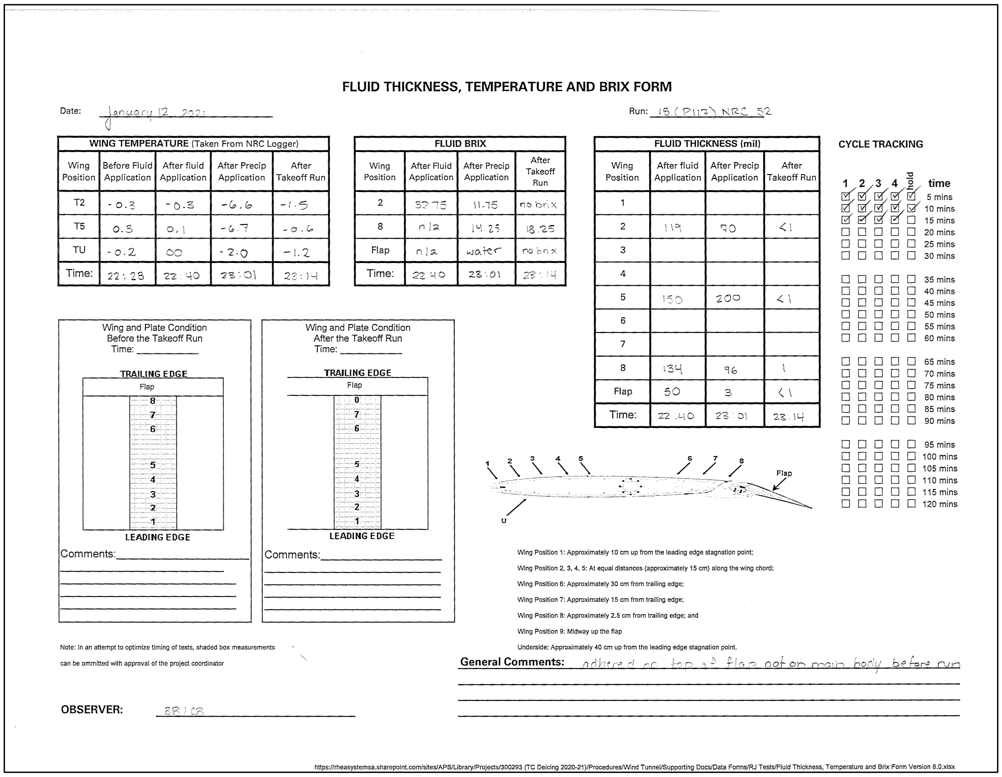
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: no adherence

OBSERVER: BB / CB

...APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C17: Run # 17



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12 2021

Run: 18 (P117) NRC 52

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.3	-0.3	-6.6	-1.5
T5	0.3	0.1	-6.7	-0.6
TU	-0.2	00	-2.0	-1.2
Time:	22:28	22:40	23:01	23:14

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	11.75	no brix
8	n/a	14.25	18.25
Flap	n/a	water	no brix
Time:	22:40	23:01	23:14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	70	<1
3			
4			
5	150	200	<1
6			
7			
8	134	96	1
Flap	50	3	<1
Time:	22:40	23:01	23:14

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
0
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

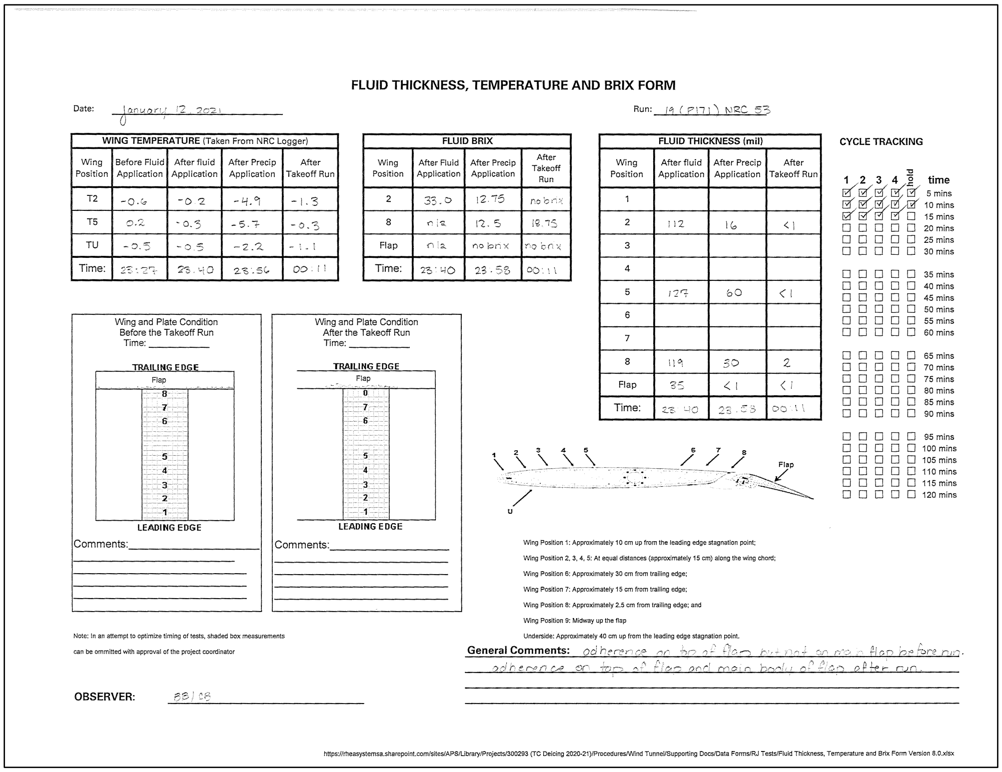
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: adhered on top of flap not on main body before run

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C18: Run # 18



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2021

Run: 19 (P171) NRC 53

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.6	-0.2	-4.9	-1.3
T5	0.2	-0.3	-5.7	-0.3
TU	-0.5	-0.5	-2.2	-1.1
Time:	23:27	23:40	23:56	00:11

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	12.75	no brix
8	n/a	12.5	18.75
Flap	n/a	no brix	no brix
Time:	23:40	23:58	00:11

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	16	<1
3			
4			
5	127	60	<1
6			
7			
8	119	30	2
Flap	35	<1	<1
Time:	23:40	23:58	00:11

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

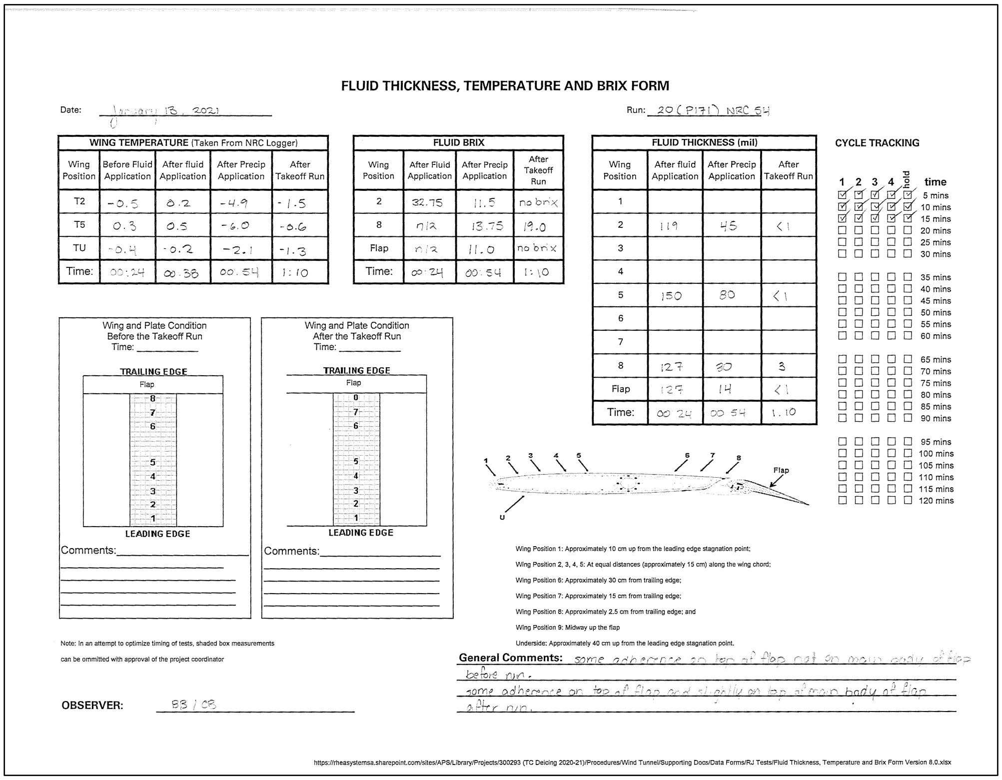
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: adherence on top of flap but not on main flap before run.
adherence on top of flap and main body of flap after run.

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C19: Run # 19



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 20 (P171) NRC 54

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.5	0.2	-4.9	-1.5
T5	0.3	0.5	-6.0	-0.6
TU	-0.4	-0.2	-2.1	-1.3
Time:	00:24	00:38	00:54	1:10

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	11.5	no brix
8	n/a	13.75	19.0
Flap	n/a	11.0	no brix
Time:	00:24	00:54	1:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	45	<1
3			
4			
5	150	80	<1
6			
7			
8	127	30	3
Flap	127	14	<1
Time:	00:24	00:54	1.10

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

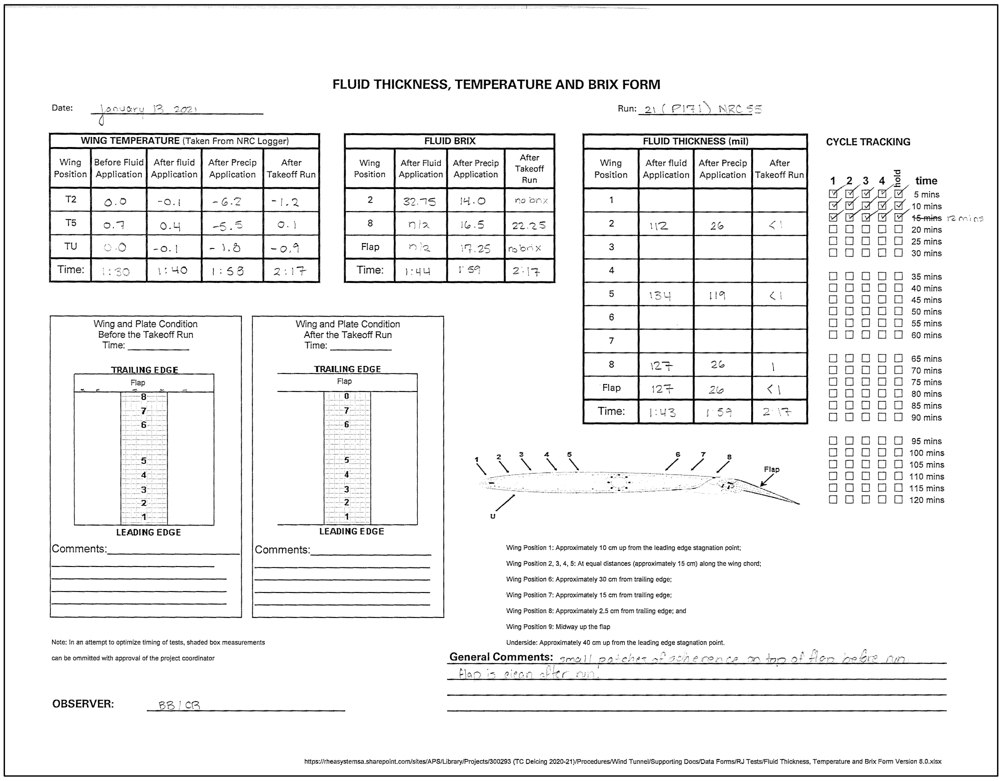
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: some adherence on top of flap not on main body of flap
before run.
some adherence on top of flap and slightly on top of main body of flap
after run.

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C20: Run # 20



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13 2021

Run: 21 (P171) NRC 55

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.0	-0.1	-6.2	-1.2
T5	0.7	0.4	-5.5	0.1
TU	0.0	-0.1	-1.8	-0.9
Time:	1:30	1:40	1:58	2:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	14.0	no brix
8	n/a	16.5	22.25
Flap	n/a	17.25	no brix
Time:	1:44	1:59	2:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	26	<1
3			
4			
5	134	119	<1
6			
7			
8	127	26	1
Flap	127	26	<1
Time:	1:43	1:59	2:17

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	~~15 mins~~ 12 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

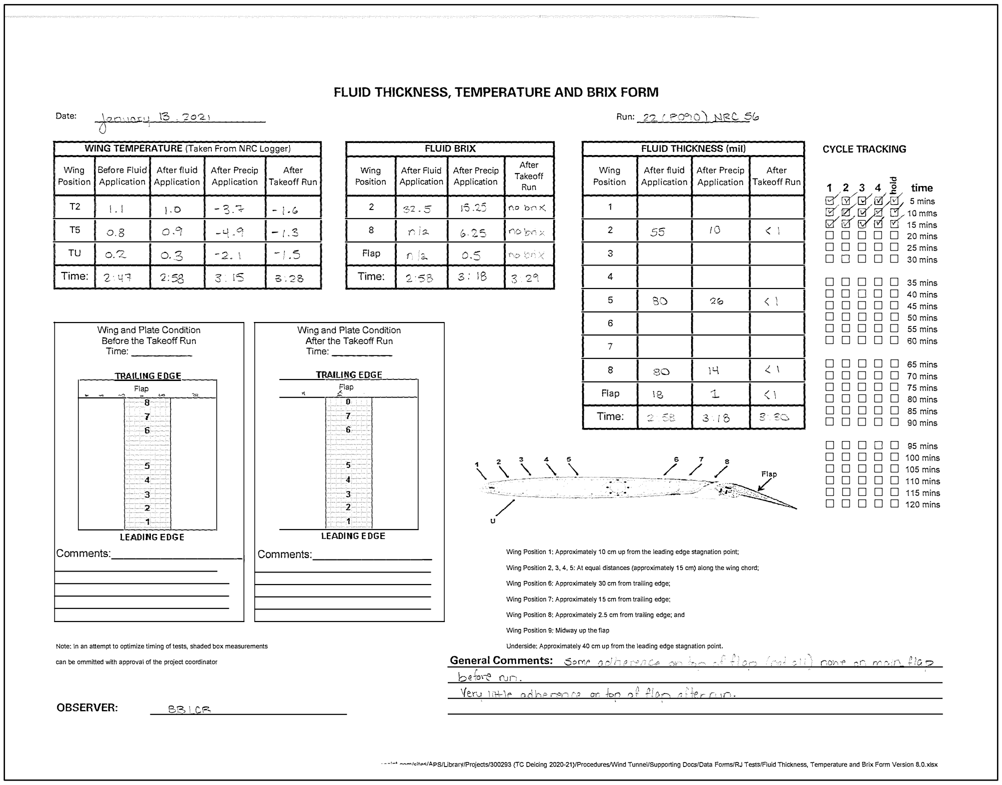
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: small patches of adherence on top of flap before run.
flap is clean after run.

OBSERVER: BB / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C21: Run # 21



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 22 (P090) NRC 56

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	1.1	1.0	-3.7	-1.6
T5	0.8	0.9	-4.9	-1.3
TU	0.2	0.3	-2.1	-1.5
Time:	2:47	2:58	3:15	3:28

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	15.25	no brix
8	n/a	6.25	no brix
Flap	n/a	0.5	no brix
Time:	2:58	3:18	3:29

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	10	<1
3			
4			
5	80	26	<1
6			
7			
8	80	14	<1
Flap	18	1	<1
Time:	2:58	3:18	3:30

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

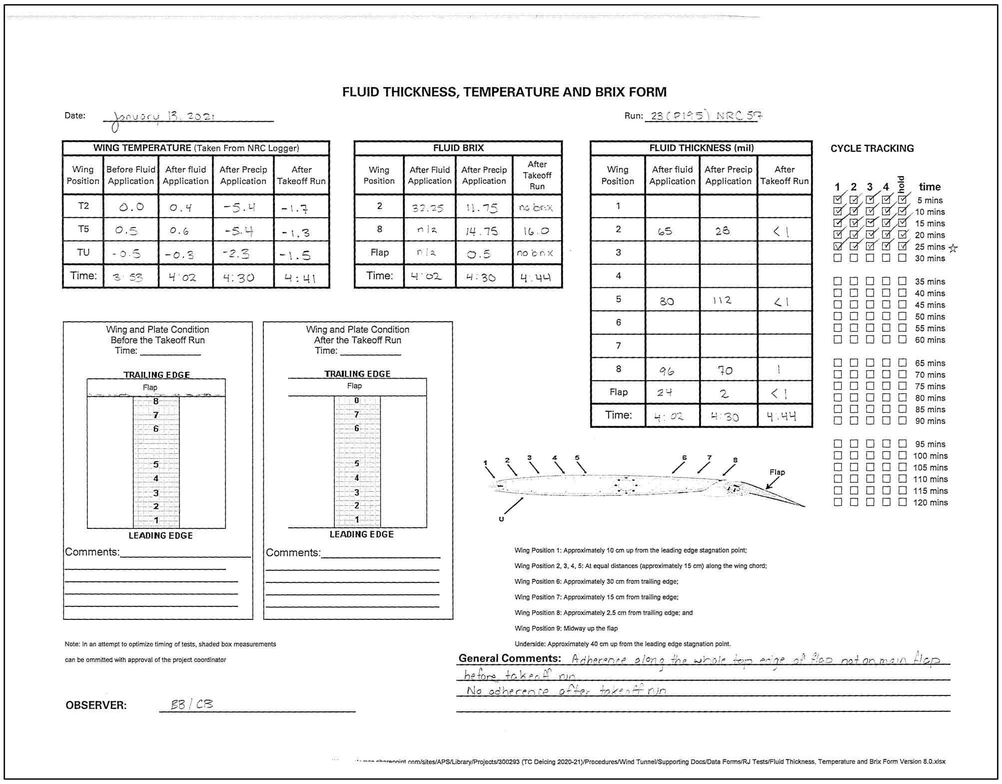
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Some adherence on top of flap (not all) none on main flap before run.
Very little adherence on top of flap after run.

OBSERVER: BB / CR

com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C22: Run # 22



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 23 (P195) NRC 57

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.0	0.4	-5.4	-1.7
T5	0.5	0.6	-5.4	-1.3
TU	-0.5	-0.3	-2.3	-1.5
Time:	3:53	4:02	4:30	4:41

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.25	11.75	no brix
8	n/a	14.75	16.0
Flap	n/a	0.5	no brix
Time:	4:02	4:30	4:44

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	28	<1
3			
4			
5	80	112	<1
6			
7			
8	96	70	1
Flap	24	2	<1
Time:	4:02	4:30	4:44

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins ☆
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:____________________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:____________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence along the whole top edge of flap not on main flap before takeoff run
No adherence after takeoff run

OBSERVER: BB / CB

sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

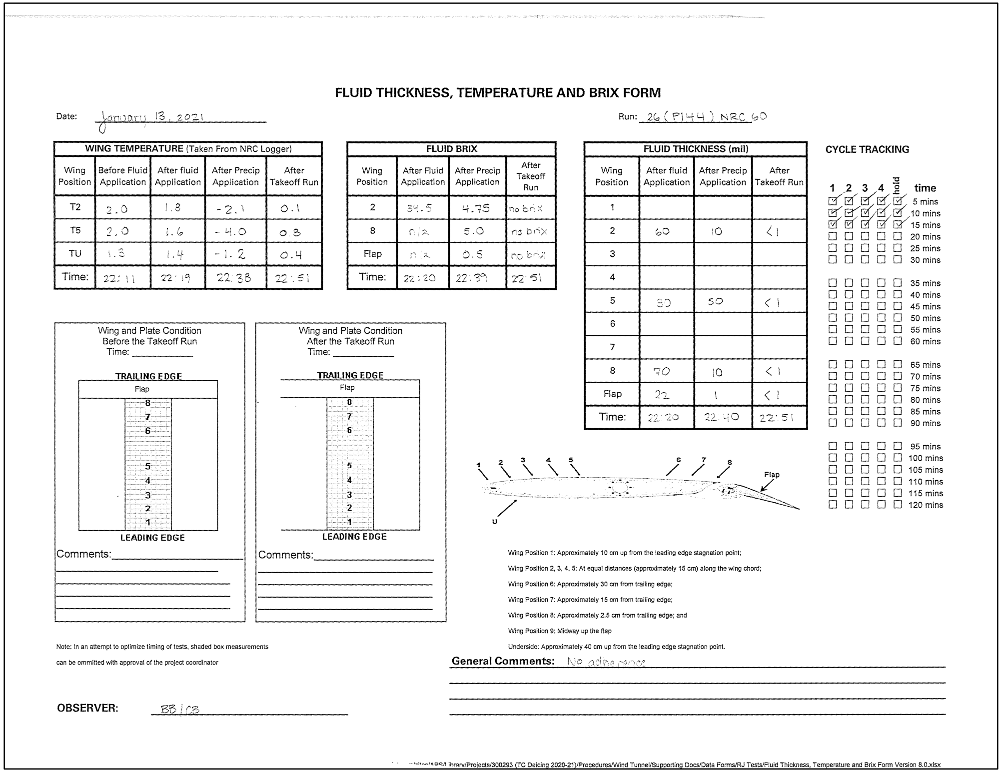
Figure C23: Run # 23

No Data Available

Figure C24: Run # 24

No Data Available

Figure C25: Run # 25



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 26 (P144) NRC 60

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	2.0	1.8	-2.1	0.1
T5	2.0	1.6	-4.0	0.8
TU	1.3	1.4	-1.2	0.4
Time:	22:11	22:19	22:38	22:51

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	4.75	no brix
8	n/a	5.0	no brix
Flap	n/a	0.5	no brix
Time:	22:20	22:39	22:51

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	10	<1
3			
4			
5	30	50	<1
6			
7			
8	70	10	<1
Flap	22	1	<1
Time:	22:20	22:40	22:51

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:___________________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:___________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

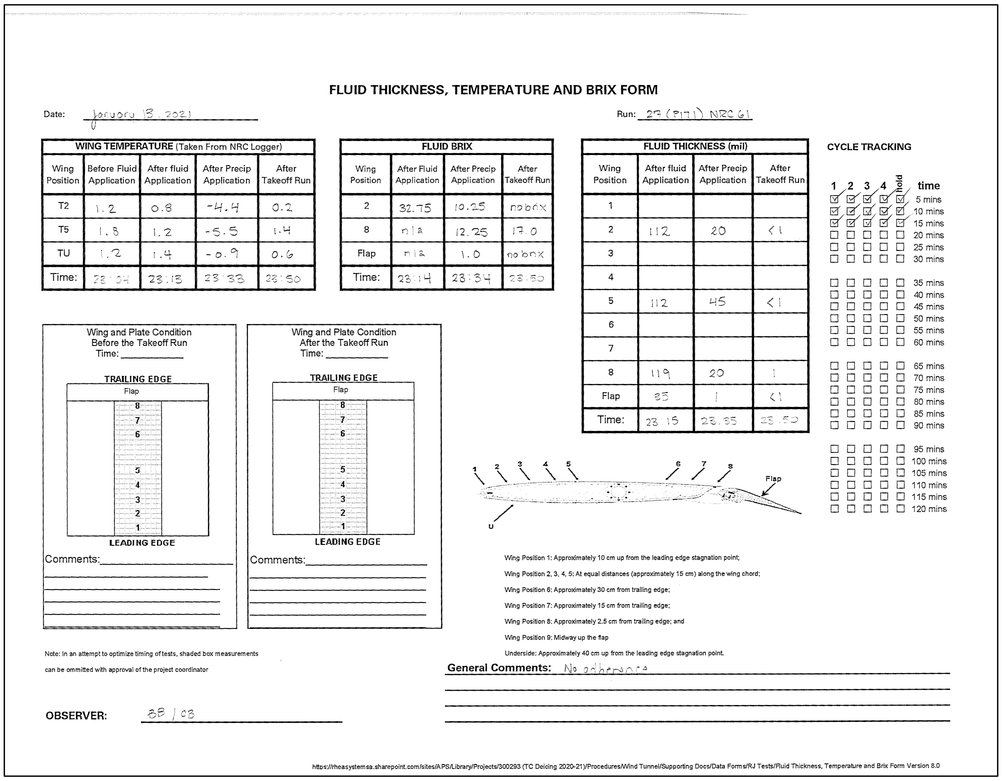
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB/CB

/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C26: Run # 26



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 27 (P171) NRC 61

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	1.2	0.8	-4.4	0.2
T5	1.8	1.2	-5.5	1.4
TU	1.2	1.4	-0.9	0.6
Time:	23:04	23:13	23:33	23:50

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	10.25	no brix
8	n/a	12.25	17.0
Flap	n/a	1.0	no brix
Time:	23:14	23:34	23:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	20	<1
3			
4			
5	112	45	<1
6			
7			
8	119	20	1
Flap	35	1	<1
Time:	23:15	23:35	23:50

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

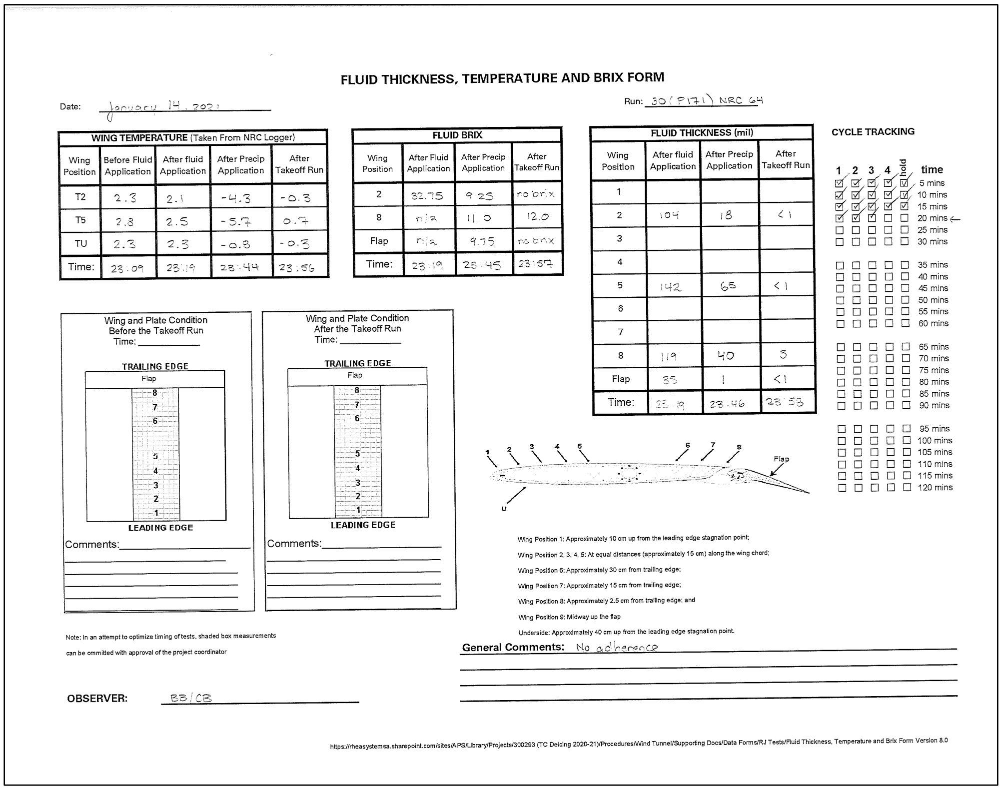
Figure C27: Run # 27

No Data Available

Figure C28: Run # 28

No Data Available

Figure C29: Run # 29



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2021

Run: 30 (P171) NRC 64

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	2.3	2.1	-4.3	-0.3
T5	2.8	2.5	-5.7	0.7
TU	2.3	2.3	-0.8	-0.3
Time:	23:09	23:19	23:44	23:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	9.25	no brix
8	n/a	11.0	12.0
Flap	n/a	9.75	no brix
Time:	23:19	23:45	23:57

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	18	<1
3			
4			
5	142	65	<1
6			
7			
8	119	40	3
Flap	35	1	<1
Time:	23:19	23:46	23:58

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☐	☐	20 mins ←
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

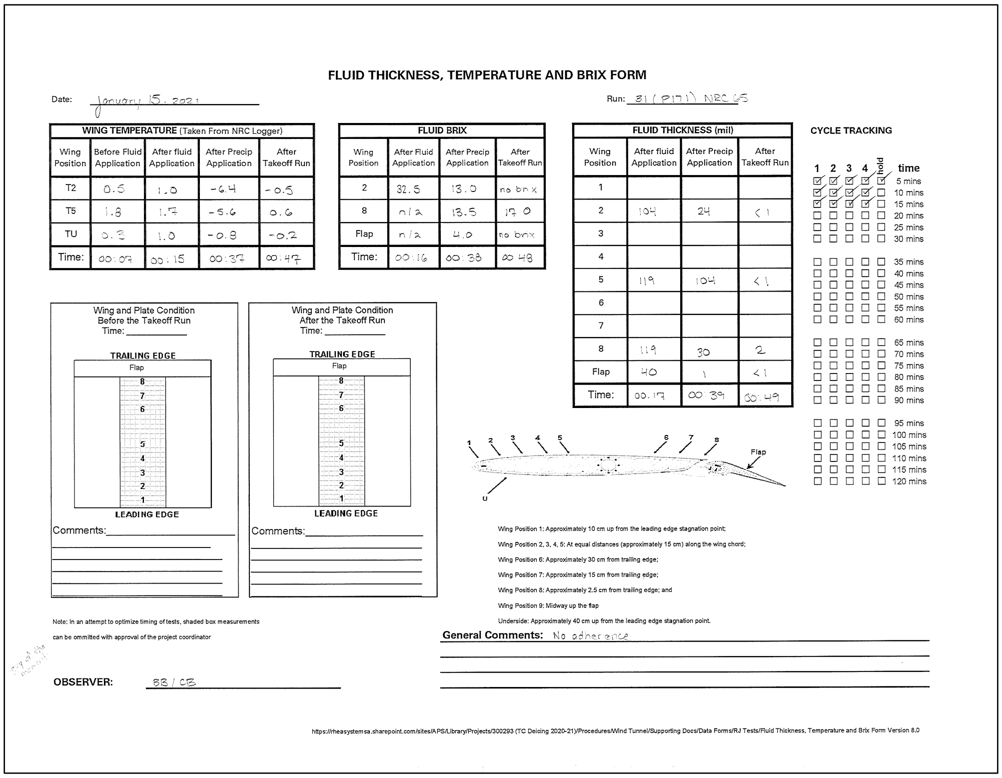
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C30: Run # 30



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 15, 2021

Run: 31 (P171) NRC 65

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.5	1.0	-6.4	-0.5
T5	1.8	1.7	-5.6	0.6
TU	0.3	1.0	-0.8	-0.2
Time:	00:07	00:15	00:37	00:47

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	13.0	no brix
8	n/a	13.5	17.0
Flap	n/a	4.0	no brix
Time:	00:16	00:38	00:48

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	24	< 1
3			
4			
5	119	104	< 1
6			
7			
8	119	30	2
Flap	40	1	< 1
Time:	00:17	00:39	00:49

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☐	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

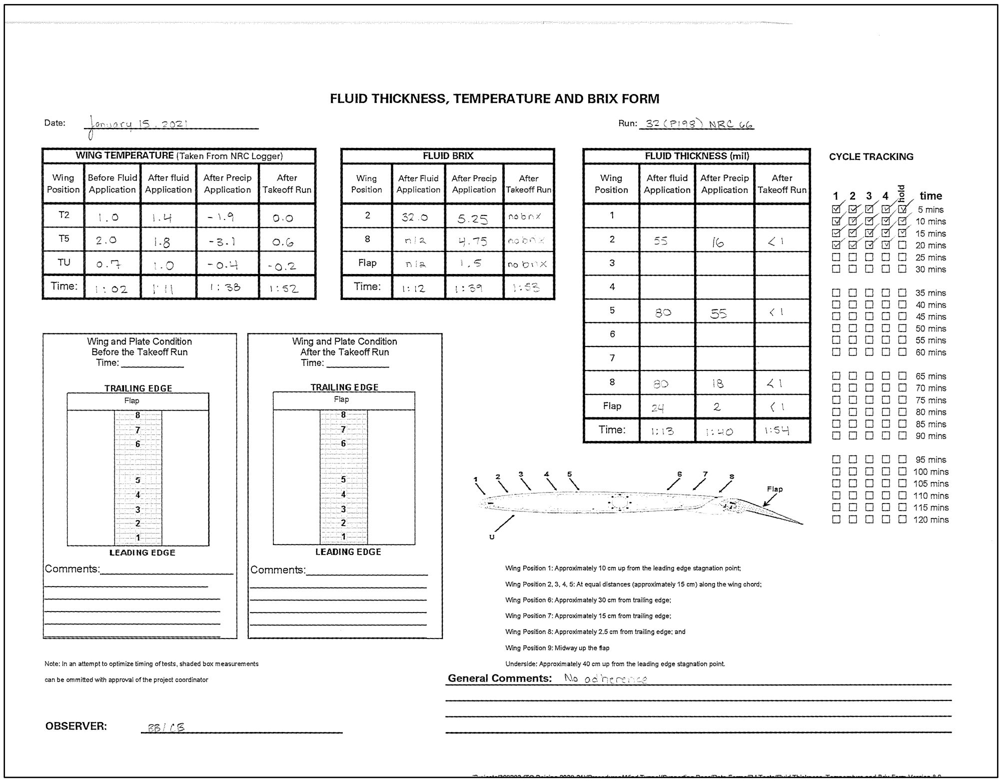
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C31: Run # 31



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 15, 2021

Run: 32 (P198) NRC 66

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	1.0	1.4	-1.9	0.0
T5	2.0	1.8	-3.1	0.6
TU	0.7	1.0	-0.4	-0.2
Time:	1:02	1:11	1:38	1:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.0	5.25	no brix
8	n/a	4.75	no brix
Flap	n/a	1.5	no brix
Time:	1:12	1:39	1:53

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	16	< 1
3			
4			
5	80	55	< 1
6			
7			
8	80	18	< 1
Flap	24	2	< 1
Time:	1:13	1:40	1:54

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
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☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
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☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

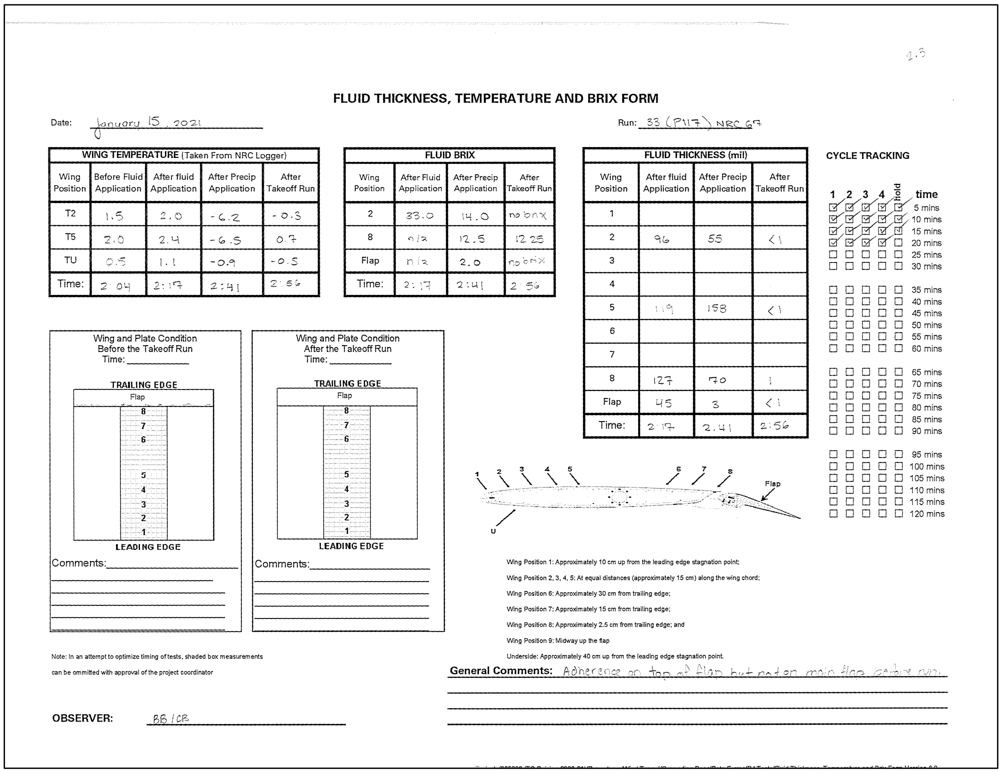
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

Figure C32: Run # 32



2.3

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 15, 2021

Run: 33 (P117) NRC 67

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	1.5	2.0	-6.2	-0.3
T5	2.0	2.4	-6.5	0.7
TU	0.5	1.1	-0.9	-0.5
Time:	2:04	2:17	2:41	2:56

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	14.0	no brix
8	n/a	12.5	12.25
Flap	n/a	2.0	no brix
Time:	2:17	2:41	2:56

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	55	<1
3			
4			
5	119	158	<1
6			
7			
8	127	70	1
Flap	45	3	<1
Time:	2:17	2:41	2:56

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
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☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

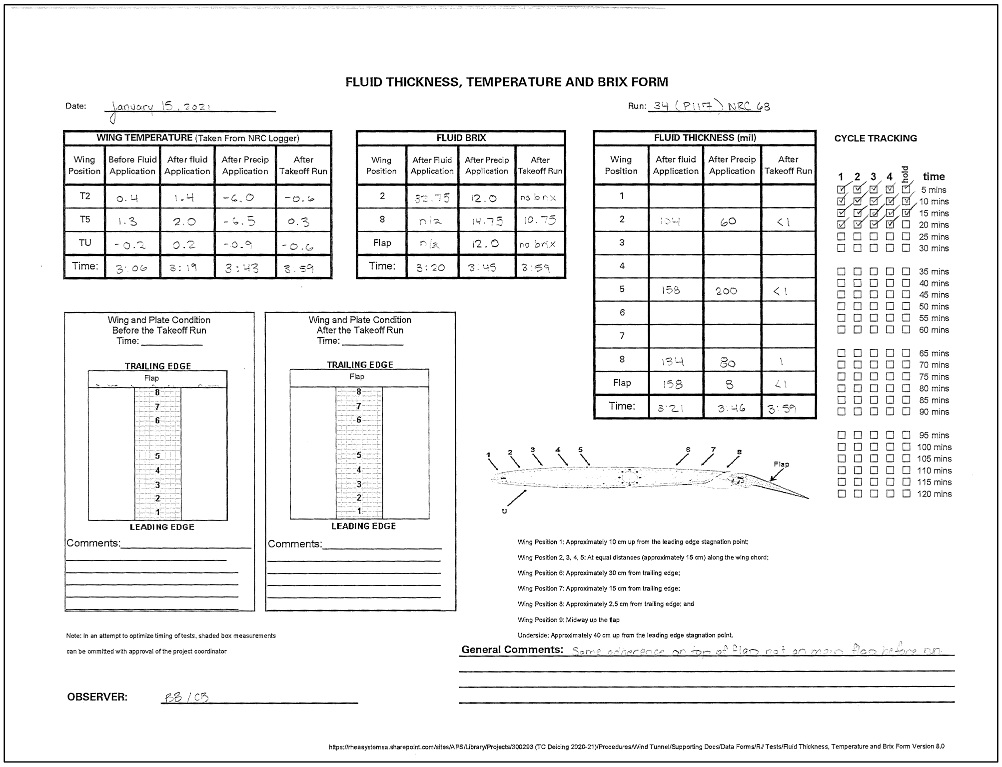
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence on top of flap but not on main flap before run.

OBSERVER: BB / CR

Figure C33: Run # 33



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 15, 2021

Run: 34 (P117) NRC 68

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.4	1.4	-6.0	-0.6
T5	1.3	2.0	-6.5	0.3
TU	-0.2	0.2	-0.9	-0.6
Time:	3:06	3:19	3:43	3:59

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	12.0	no brix
8	n/a	14.75	10.75
Flap	n/a	12.0	no brix
Time:	3:20	3:45	3:59

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	60	<1
3			
4			
5	158	200	<1
6			
7			
8	134	80	1
Flap	158	8	<1
Time:	3:21	3:46	3:59

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

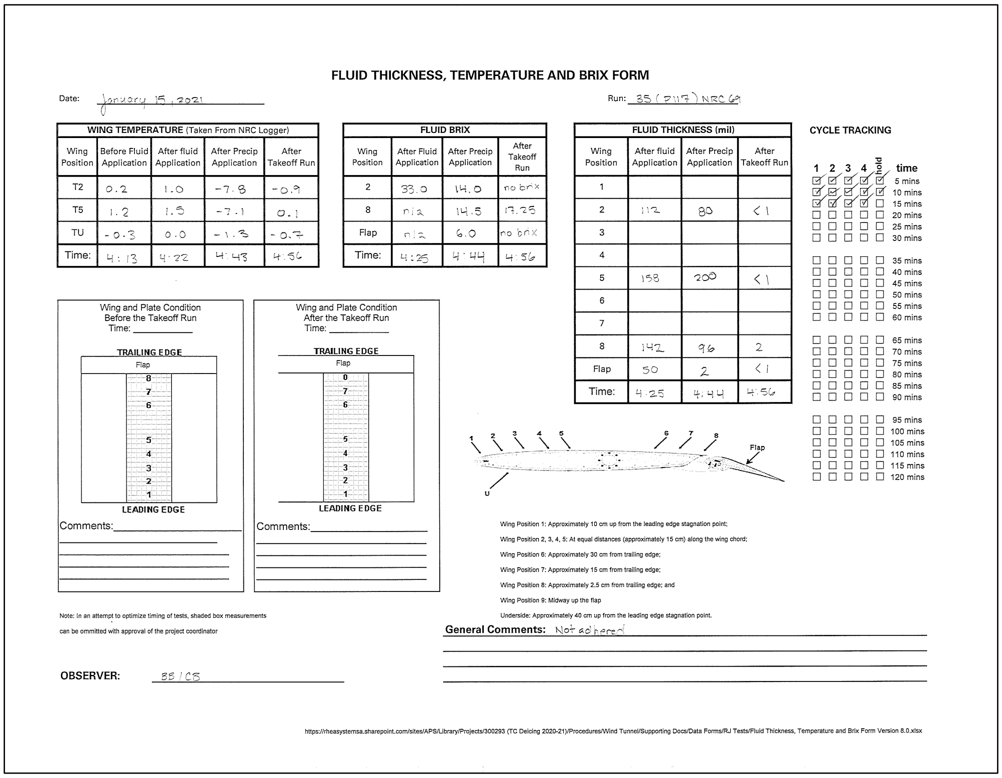
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Some adherence on top of flap not on main flap before run.

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C34: Run # 34



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 15, 2021

Run: 35 (P117) NRC 69

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	0.2	1.0	-7.8	-0.9
T5	1.2	1.5	-7.1	0.1
TU	-0.3	0.0	-1.3	-0.7
Time:	4:13	4:22	4:43	4:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	14.0	no brix
8	n/a	14.5	17.25
Flap	n/a	6.0	no brix
Time:	4:25	4:44	4:56

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	80	<1
3			
4			
5	158	200	<1
6			
7			
8	142	96	2
Flap	50	2	<1
Time:	4:25	4:44	4:56

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
0
7
6
5
4
3
2
1
LEADING EDGE

Comments:____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Not adhered

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

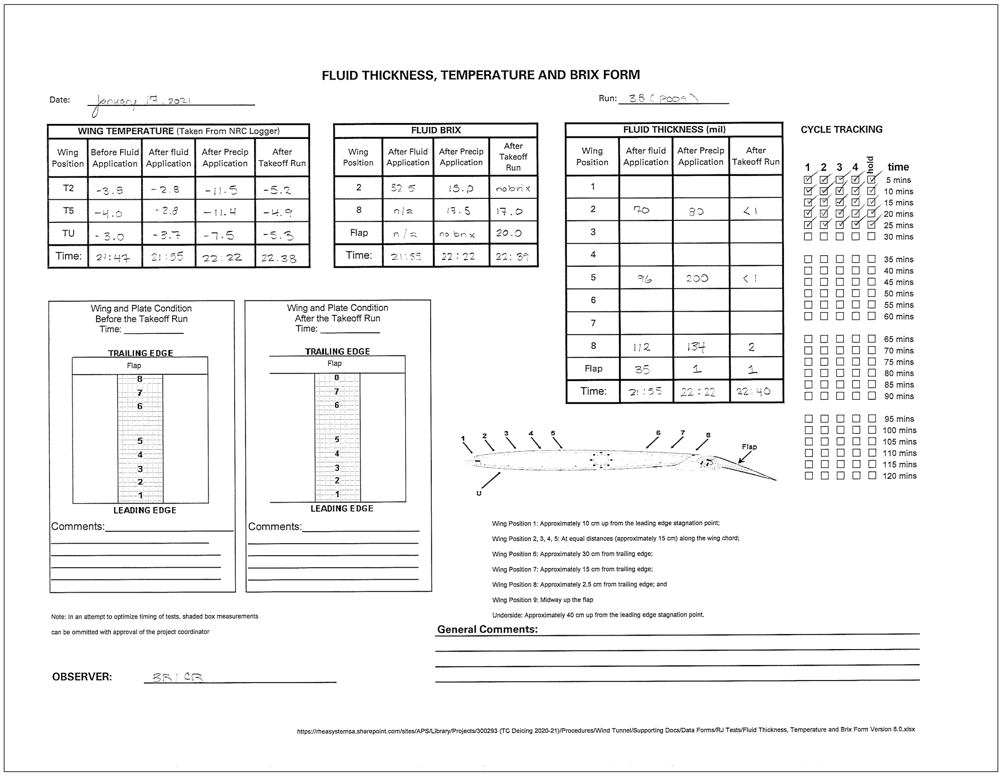
Figure C35: Run # 35

No Data Available

Figure C36: Run # 36

No Data Available

Figure C37: Run # 37



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2021

Run: 38 (P009)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.8	-2.8	-11.5	-5.2
T5	-4.0	-2.8	-11.4	-4.9
TU	-3.0	-3.7	-7.5	-5.3
Time:	21:47	21:55	22:22	22:38

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	15.0	no brix
8	n/a	17.5	17.0
Flap	n/a	no brix	20.0
Time:	21:55	22:22	22:39

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	80	<1
3			
4			
5	96	200	<1
6			
7			
8	112	134	2
Flap	35	1	1
Time:	21:55	22:22	22:40

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

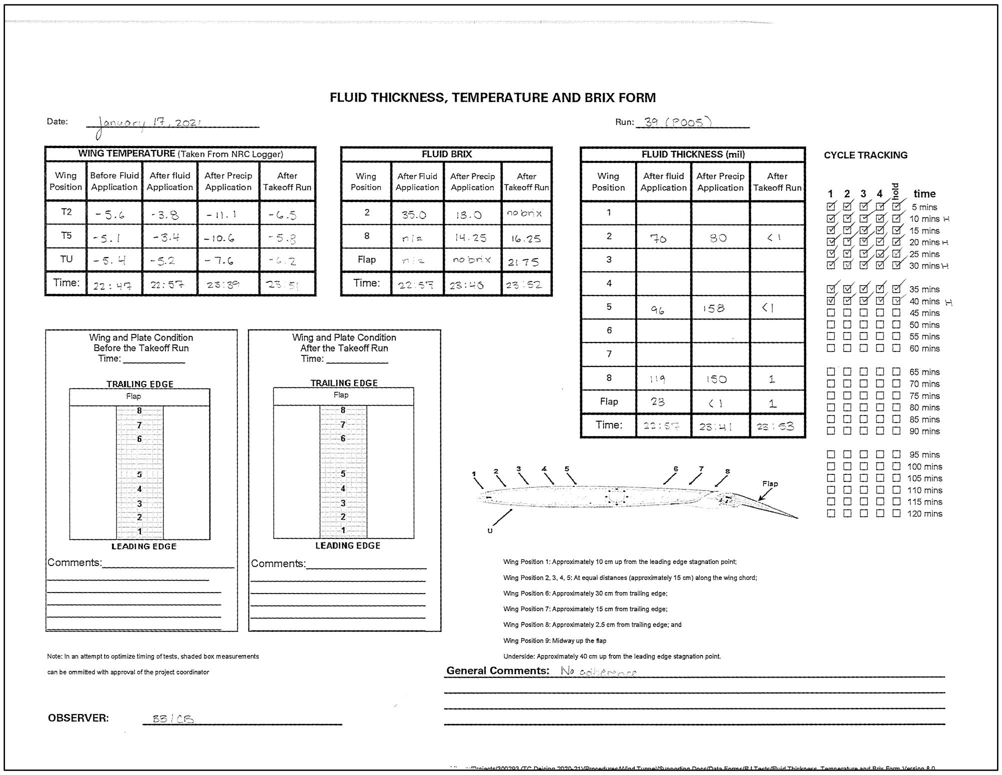
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BR / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C38: Run # 38



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2021

Run: 39 (P005)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.6	-3.8	-11.1	-6.5
T5	-5.1	-3.4	-10.6	-5.8
TU	-5.4	-5.2	-7.6	-6.2
Time:	22:47	22:57	23:39	23:51

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	13.0	no brix
8	n/a	14.25	16.25
Flap	n/a	no brix	21.75
Time:	22:57	23:46	23:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	80	<1
3			
4			
5	96	158	<1
6			
7			
8	119	150	1
Flap	28	<1	1
Time:	22:57	23:41	23:53

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins H
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins H
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins H
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins H
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

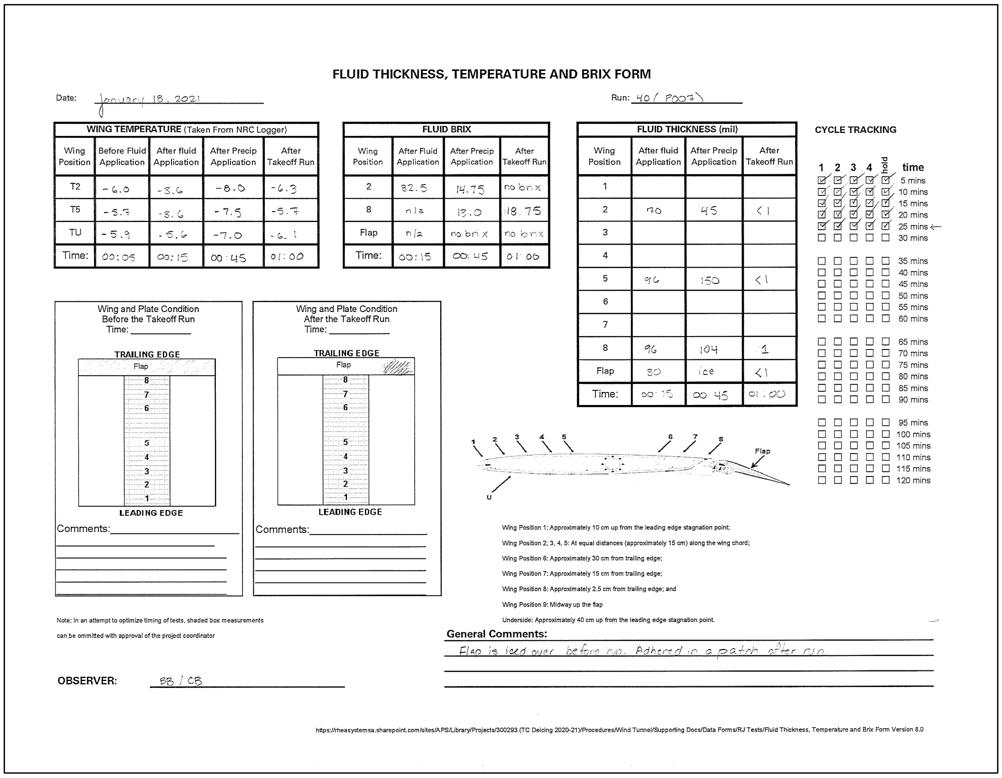
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C39: Run # 39



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 40 (P007)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.0	-3.6	-8.0	-6.3
T5	-5.7	-3.6	-7.5	-5.7
TU	-5.9	-5.6	-7.0	-6.1
Time:	00:05	00:15	00:45	01:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	14.75	no brix
8	n/a	13.0	18.75
Flap	n/a	no brix	no brix
Time:	00:15	00:45	01:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	45	<1
3			
4			
5	96	150	<1
6			
7			
8	96	104	<1
Flap	30	ice	<1
Time:	00:15	00:45	01:00

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins ←
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

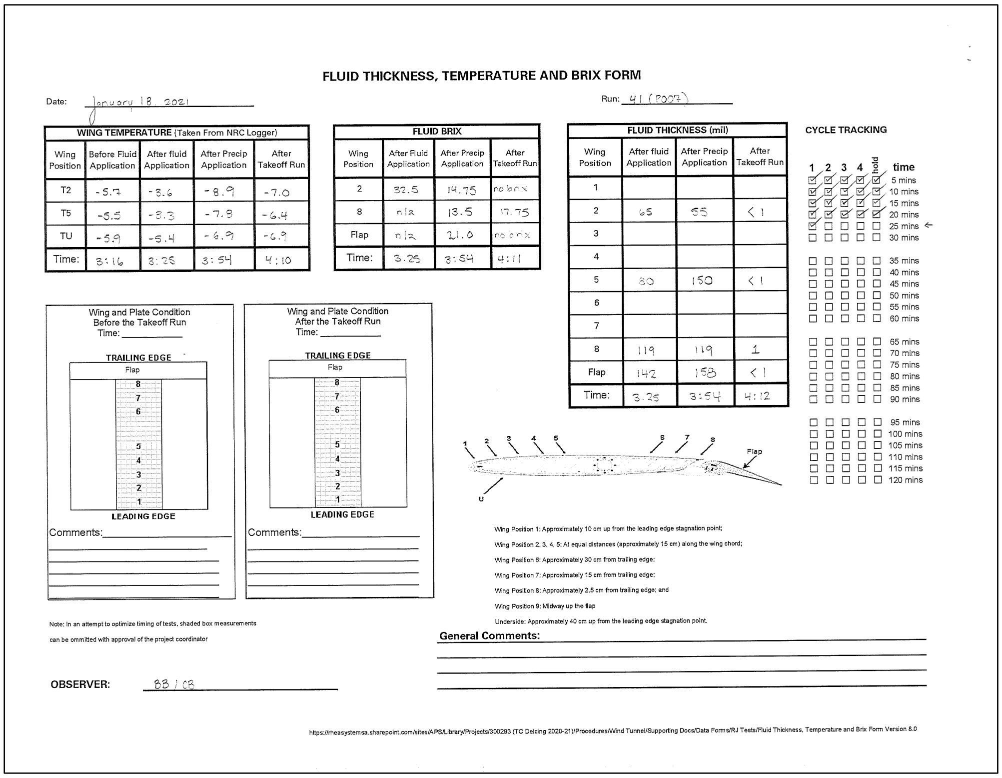
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:
Flap is iced over before run. Adhered in a patch after run.

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C40: Run # 40



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 41 (P007)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.7	-3.6	-8.9	-7.0
T5	-5.5	-3.3	-7.8	-6.4
TU	-5.9	-5.4	-6.9	-6.9
Time:	3:16	3:25	3:54	4:10

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	14.75	no brix
8	n/a	13.5	17.75
Flap	n/a	21.0	no brix
Time:	3.25	3:54	4:11

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	55	< 1
3			
4			
5	80	150	< 1
6			
7			
8	119	119	1
Flap	142	158	< 1
Time:	3.25	3:54	4:12

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☐	☐	☐	☐	25 mins ←
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

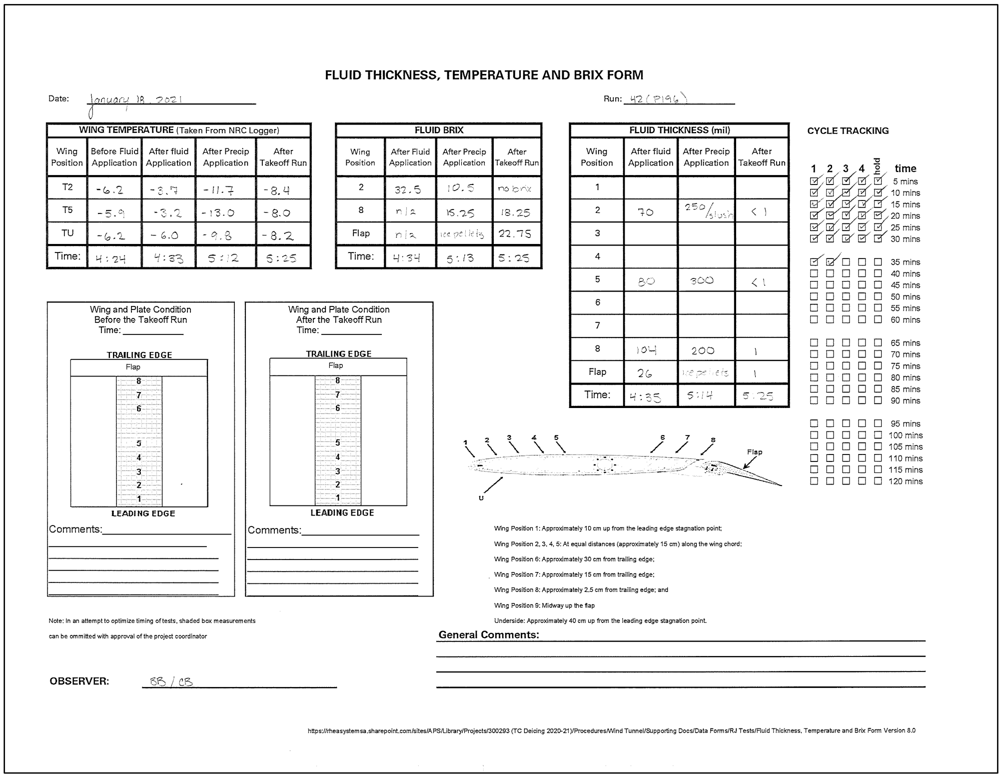
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C41: Run # 41



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 42 (P196)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.2	-3.7	-11.7	-8.4
T5	-5.9	-3.2	-13.0	-8.0
TU	-6.2	-6.0	-9.8	-8.2
Time:	4:24	4:33	5:12	5:25

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	10.5	no brix
8	n/a	15.25	18.25
Flap	n/a	ice pellets	22.75
Time:	4:34	5:13	5:25

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	250/slush	< 1
3			
4			
5	80	300	< 1
6			
7			
8	104	200	1
Flap	26	ice pellets	1
Time:	4:35	5:14	5:25

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

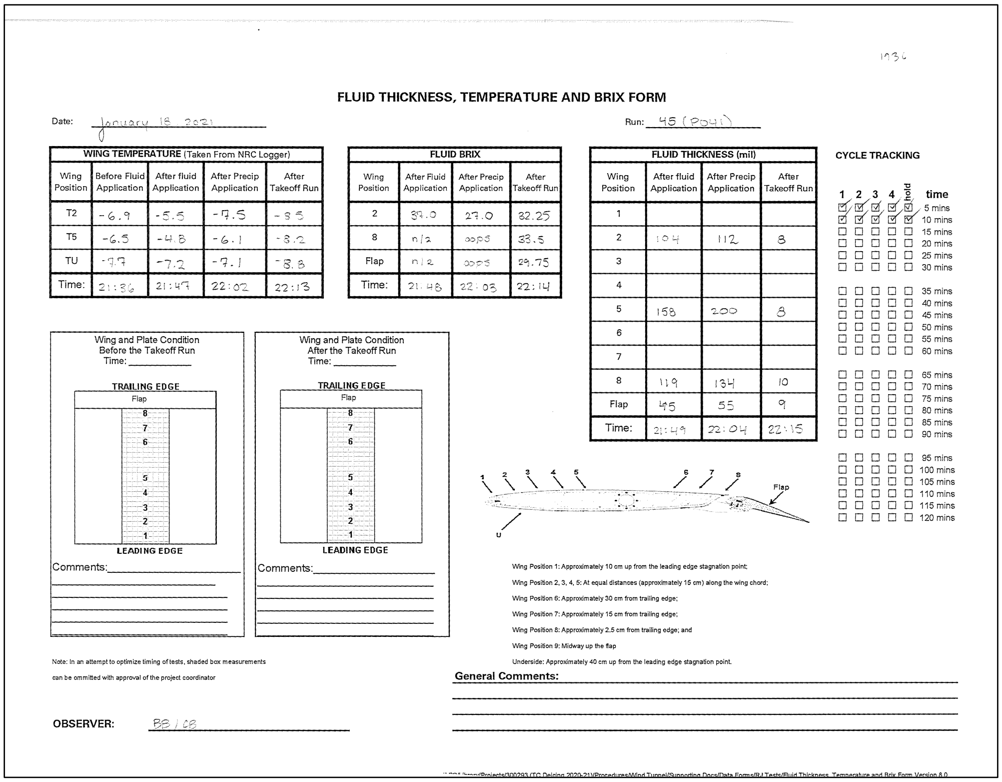
Figure C42: Run # 42

No Data Available

Figure C43: Run # 43

No Data Available

Figure C44: Run # 44



1936

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 45 (P041)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.9	-5.5	-7.5	-8.5
T5	-6.5	-4.8	-6.1	-8.2
TU	-7.7	-7.2	-7.1	-8.8
Time:	21:36	21:47	22:02	22:13

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	27.0	32.25
8	n/a	oops	33.5
Flap	n/a	oops	29.75
Time:	21:48	22:03	22:14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	112	8
3			
4			
5	158	200	8
6			
7			
8	119	134	10
Flap	45	55	9
Time:	21:49	22:04	22:15

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

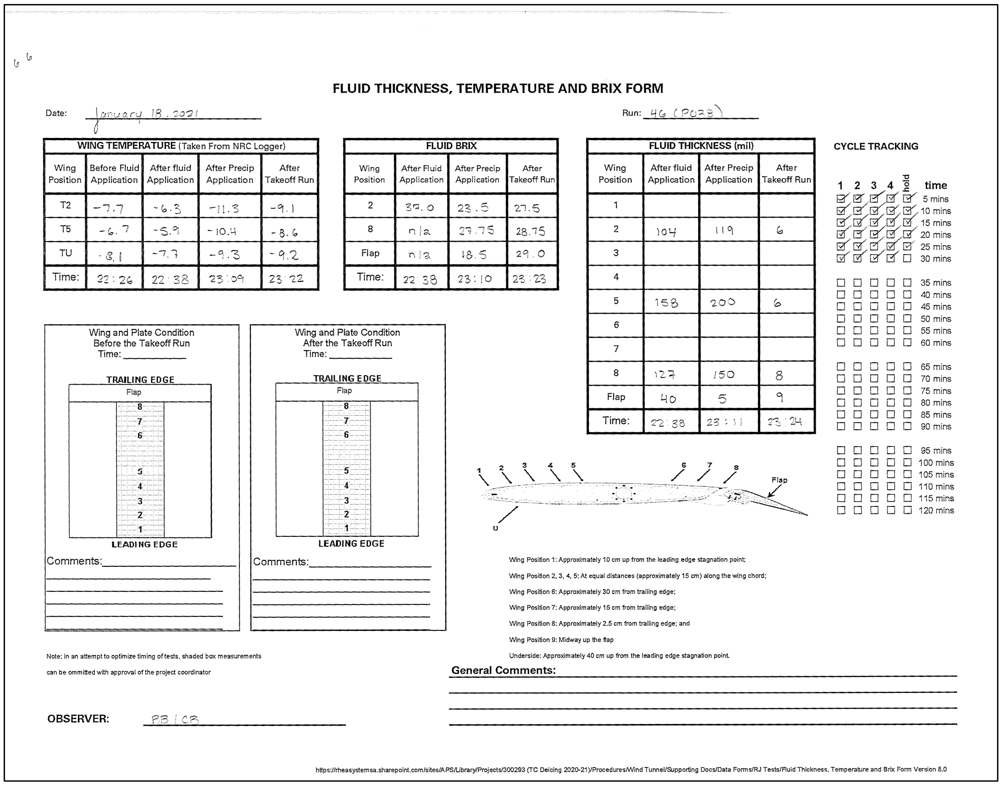
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

Figure C45: Run # 45



6 6

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 46 (P028)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.7	-6.3	-11.3	-9.1
T5	-6.7	-5.9	-10.4	-8.6
TU	-8.1	-7.7	-9.3	-9.2
Time:	22:26	22:38	23:09	23:22

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	23.5	27.5
8	n/a	27.75	28.75
Flap	n/a	18.5	29.0
Time:	22:38	23:10	23:23

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	119	6
3			
4			
5	158	200	6
6			
7			
8	127	150	8
Flap	40	5	9
Time:	22:38	23:11	23:24

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

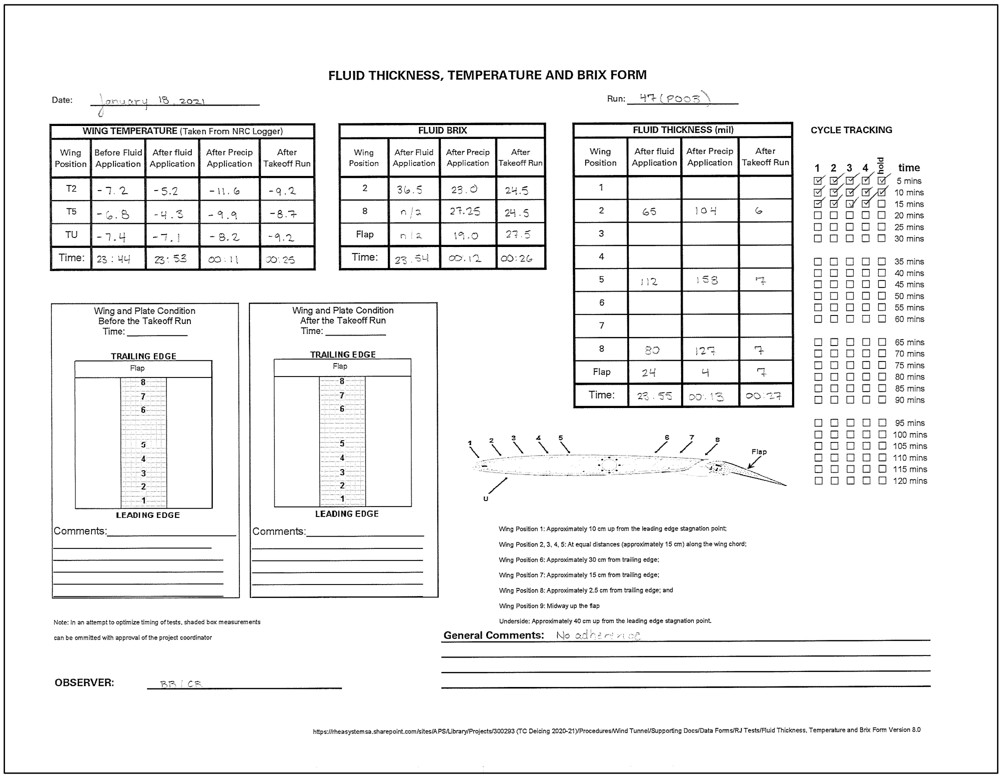
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: PB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C46: Run # 46



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2021

Run: 47 (P003)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.2	-5.2	-11.6	-9.2
T5	-6.8	-4.3	-9.9	-8.7
TU	-7.4	-7.1	-8.2	-9.2
Time:	23:44	23:53	00:11	00:25

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	23.0	24.5
8	n/a	27.25	24.5
Flap	n/a	19.0	27.5
Time:	23.54	00:12	00:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	104	6
3			
4			
5	112	158	7
6			
7			
8	80	127	7
Flap	24	4	7
Time:	23.55	00:13	00:27

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

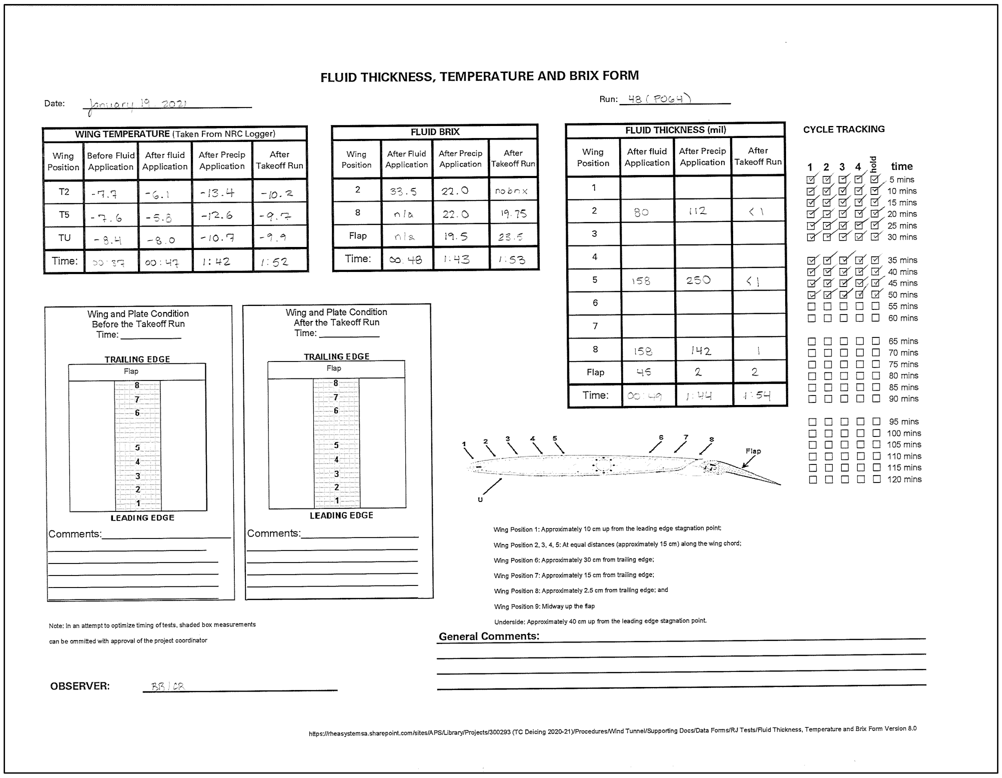
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BR / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C47: Run # 47



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 48 (P064)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.7	-6.1	-13.4	-10.2
T5	-7.6	-5.8	-12.6	-9.7
TU	-8.4	-8.0	-10.7	-9.9
Time:	00:37	00:47	1:42	1:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	22.0	no brix
8	n/a	22.0	19.75
Flap	n/a	19.5	23.5
Time:	00:48	1:43	1:53

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	112	<1
3			
4			
5	158	250	<1
6			
7			
8	158	142	1
Flap	45	2	2
Time:	00:49	1:44	1:54

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

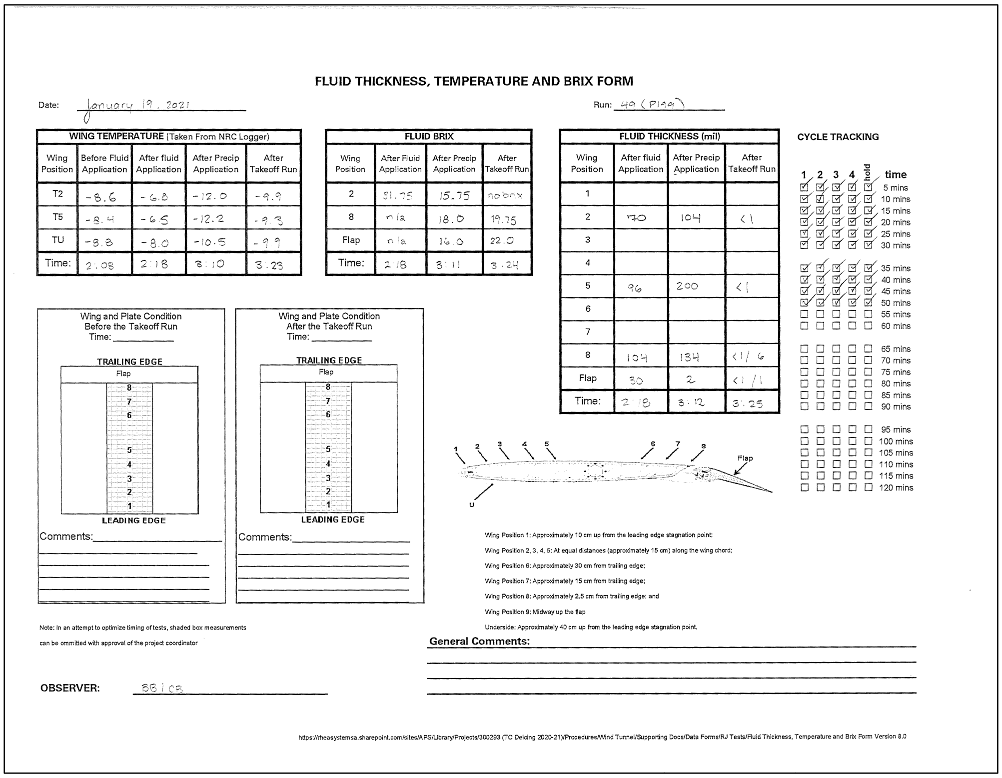
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BR / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C48: Run # 48



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 49 (P199)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-8.6	-6.8	-12.0	-9.9
T5	-8.4	-6.5	-12.2	-9.3
TU	-8.8	-8.0	-10.5	-9.9
Time:	2:08	2:18	3:10	3:23

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	31.75	15.75	no brix
8	n/a	18.0	19.75
Flap	n/a	16.0	22.0
Time:	2:18	3:11	3:24

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	104	<1
3			
4			
5	96	200	<1
6			
7			
8	104	134	<1/6
Flap	30	2	<1/1
Time:	2:18	3:12	3:25

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

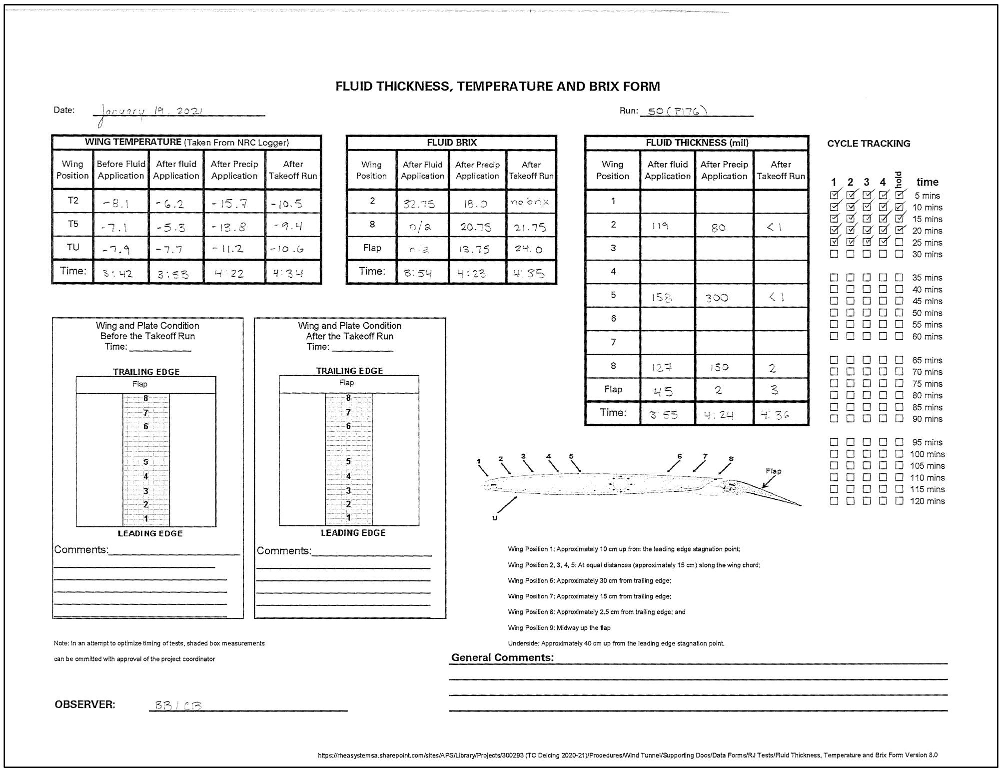
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C49: Run # 49



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 50 (P176)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-8.1	-6.2	-15.7	-10.5
T5	-7.1	-5.3	-13.8	-9.4
TU	-7.9	-7.7	-11.2	-10.6
Time:	3:42	3:53	4:22	4:34

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	18.0	no brix
8	n/a	20.75	21.75
Flap	n/a	13.75	24.0
Time:	3:54	4:23	4:35

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	80	<1
3			
4			
5	158	300	<1
6			
7			
8	127	150	2
Flap	45	2	3
Time:	3:55	4:24	4:36

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

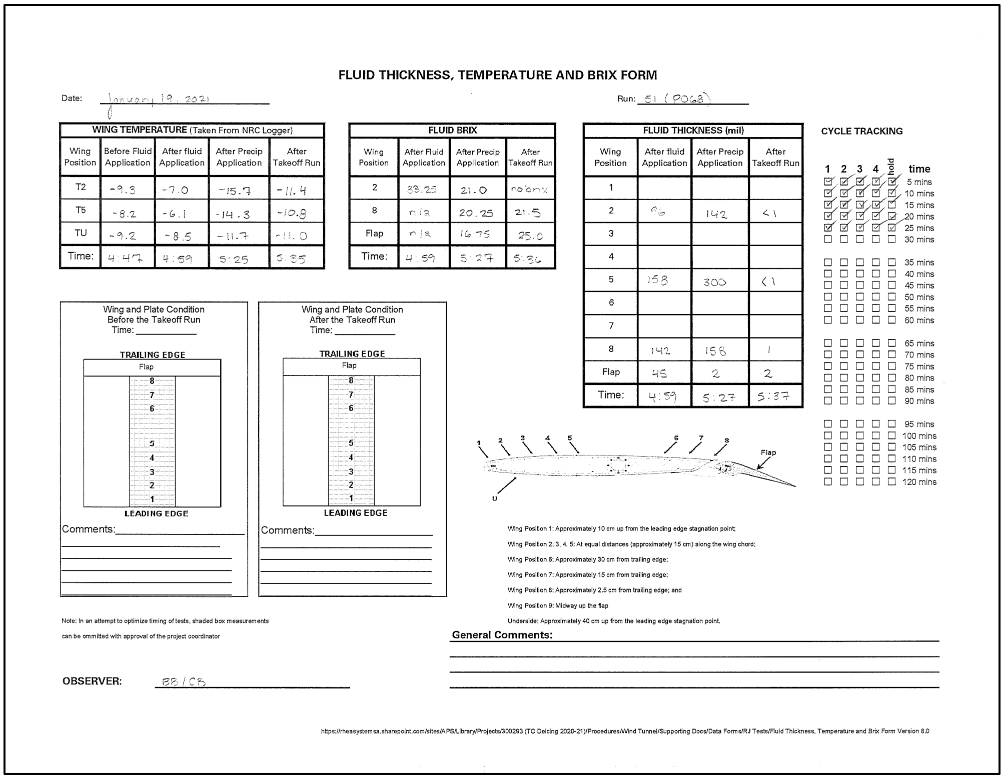
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C50: Run # 50



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 51 (P068)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.3	-7.0	-15.7	-11.4
T5	-8.2	-6.1	-14.3	-10.8
TU	-9.2	-8.5	-11.7	-11.0
Time:	4:47	4:59	5:25	5:35

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	21.0	no brix
8	n/a	20.25	21.5
Flap	n/a	16.75	25.0
Time:	4:59	5:27	5:36

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	142	<1
3			
4			
5	158	300	<1
6			
7			
8	142	158	1
Flap	45	2	2
Time:	4:59	5:27	5:37

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

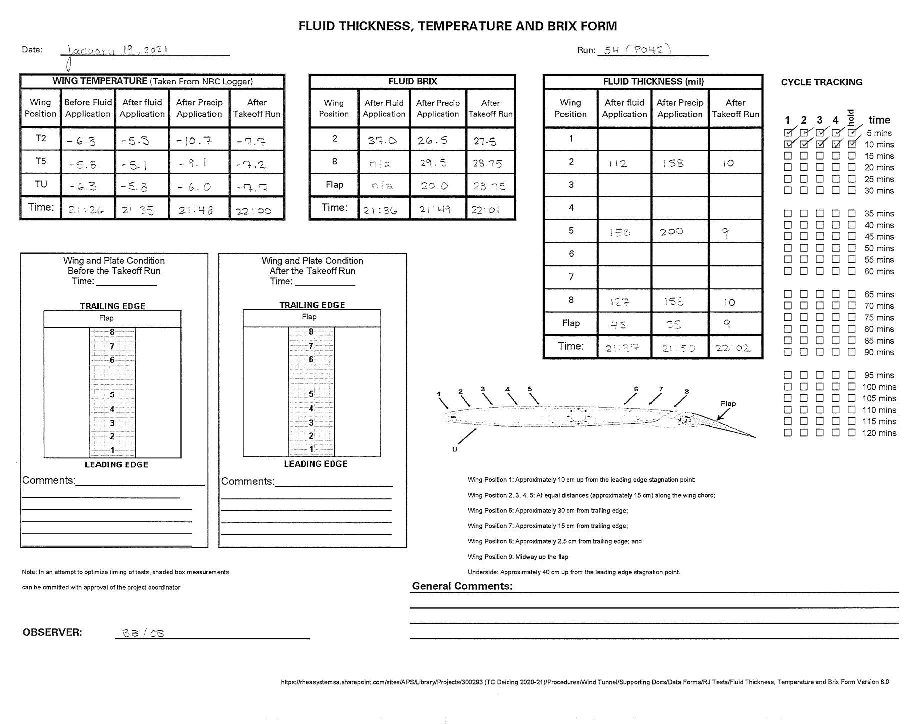
Figure C51: Run # 51

No Data Available

Figure C52: Run # 52

No Data Available

Figure C53: Run # 53



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 54 (P042)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.3	-5.3	-10.7	-7.7
T5	-5.8	-5.1	-9.1	-7.2
TU	-6.3	-5.8	-6.0	-7.7
Time:	21:26	21:35	21:48	22:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	26.5	27.5
8	n/a	29.5	28.75
Flap	n/a	20.0	28.75
Time:	21:36	21:49	22:01

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	158	10
3			
4			
5	158	200	9
6			
7			
8	127	158	10
Flap	45	55	9
Time:	21:37	21:50	22:02

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: __________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: __________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

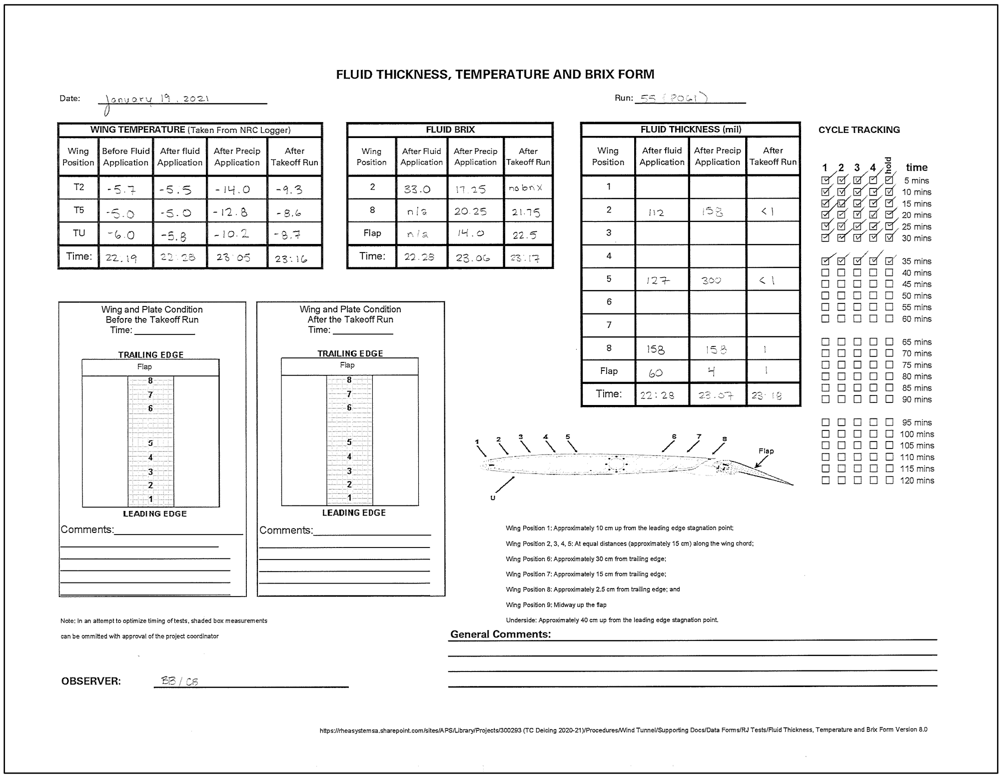
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C54: Run # 54



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 55 (P061)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.7	-5.5	-14.0	-9.3
T5	-5.0	-5.0	-12.8	-8.6
TU	-6.0	-5.8	-10.2	-8.7
Time:	22.19	22:28	23:05	23:16

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	17.25	no brix
8	n/a	20.25	21.75
Flap	n/a	14.0	22.5
Time:	22.28	23.06	23:17

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	158	<1
3			
4			
5	127	300	<1
6			
7			
8	158	158	1
Flap	60	4	1
Time:	22:28	23.07	23:18

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

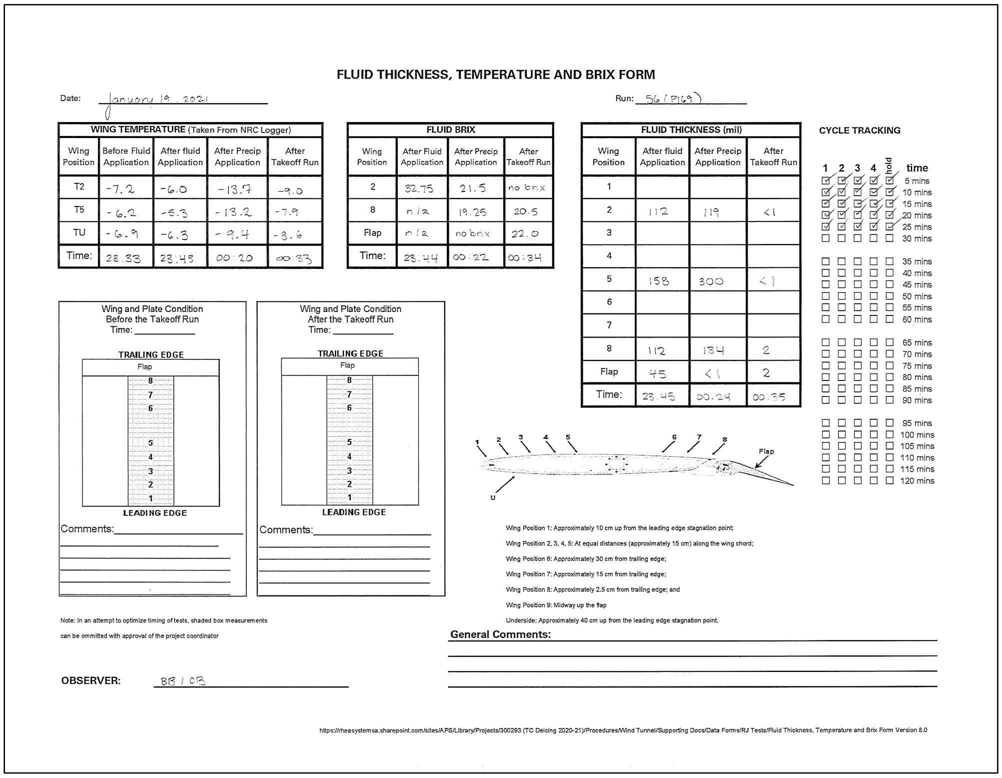
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C55: Run # 55



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2021

Run: 56 (P169)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.2	-6.0	-13.7	-9.0
T5	-6.2	-5.3	-13.2	-7.9
TU	-6.9	-6.3	-9.4	-8.6
Time:	23:33	23:43	00:20	00:33

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	21.5	no brix
8	n/a	19.25	20.5
Flap	n/a	no brix	22.0
Time:	23:44	00:22	00:34

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	119	<1
3			
4			
5	158	300	<1
6			
7			
8	112	134	2
Flap	45	<1	2
Time:	23.45	00:24	00:35

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

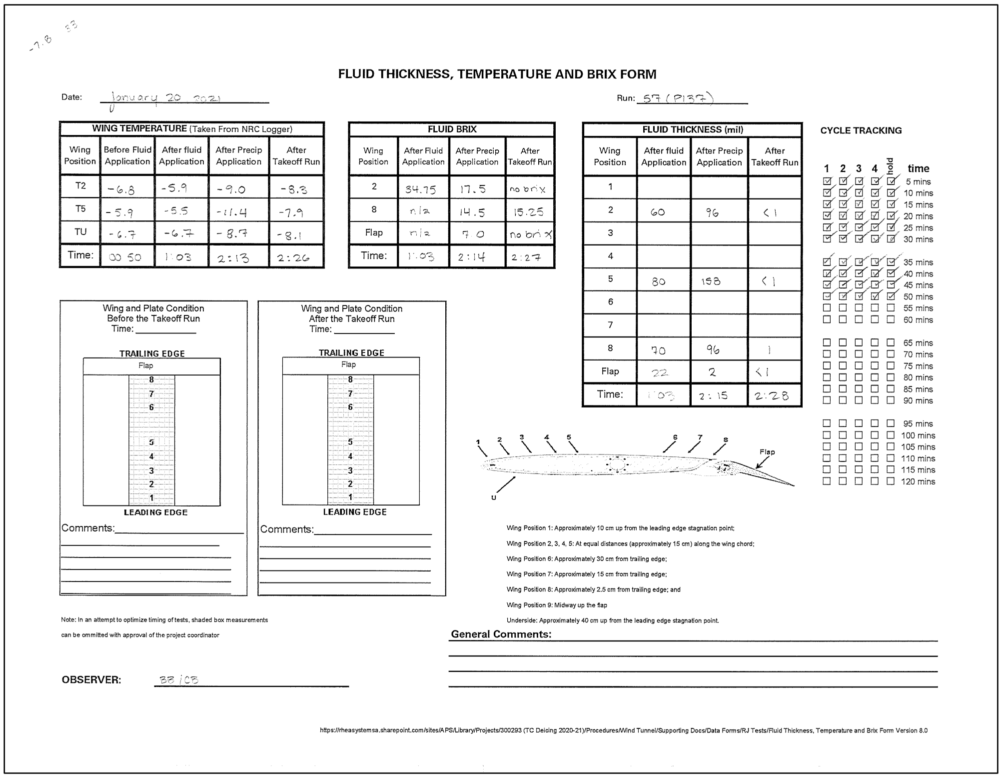
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C56: Run # 56



-7.8 33

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20 2021

Run: 57 (P137)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.8	-5.9	-9.0	-8.3
T5	-5.9	-5.5	-11.4	-7.9
TU	-6.7	-6.7	-8.7	-8.1
Time:	00 50	1:03	2:13	2:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	17.5	no brix
8	n/a	14.5	15.25
Flap	n/a	7.0	no brix
Time:	1:03	2:14	2:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	96	<1
3			
4			
5	80	158	<1
6			
7			
8	70	96	1
Flap	22	2	<1
Time:	1:03	2:15	2:28

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

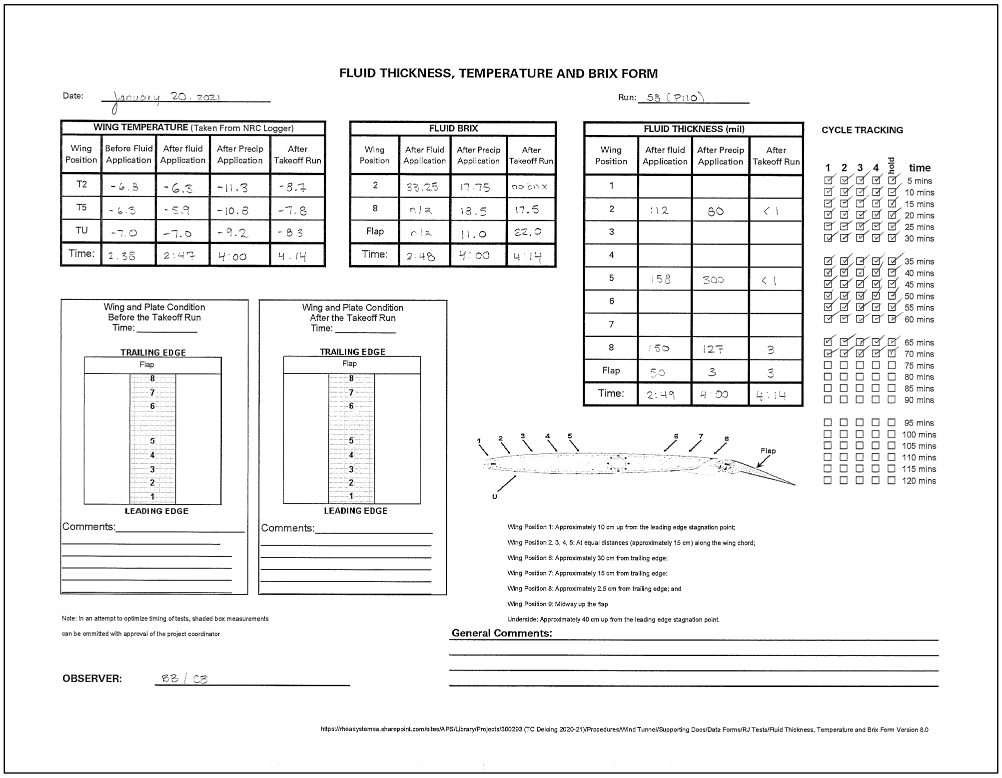
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C57: Run # 57



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2021

Run: 58 (P110)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.8	-6.3	-11.3	-8.7
T5	-6.3	-5.9	-10.8	-7.8
TU	-7.0	-7.0	-9.2	-8.3
Time:	2.38	2:47	4:00	4.14

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	17.75	no brix
8	n/a	18.5	17.5
Flap	n/a	11.0	22.0
Time:	2:48	4:00	4:14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	80	<1
3			
4			
5	158	300	<1
6			
7			
8	150	127	3
Flap	50	3	3
Time:	2:49	4:00	4:14

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☑	☑	☑	☑	☑	55 mins
☑	☑	☑	☑	☑	60 mins
☑	☑	☑	☑	☑	65 mins
☑	☑	☑	☑	☑	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

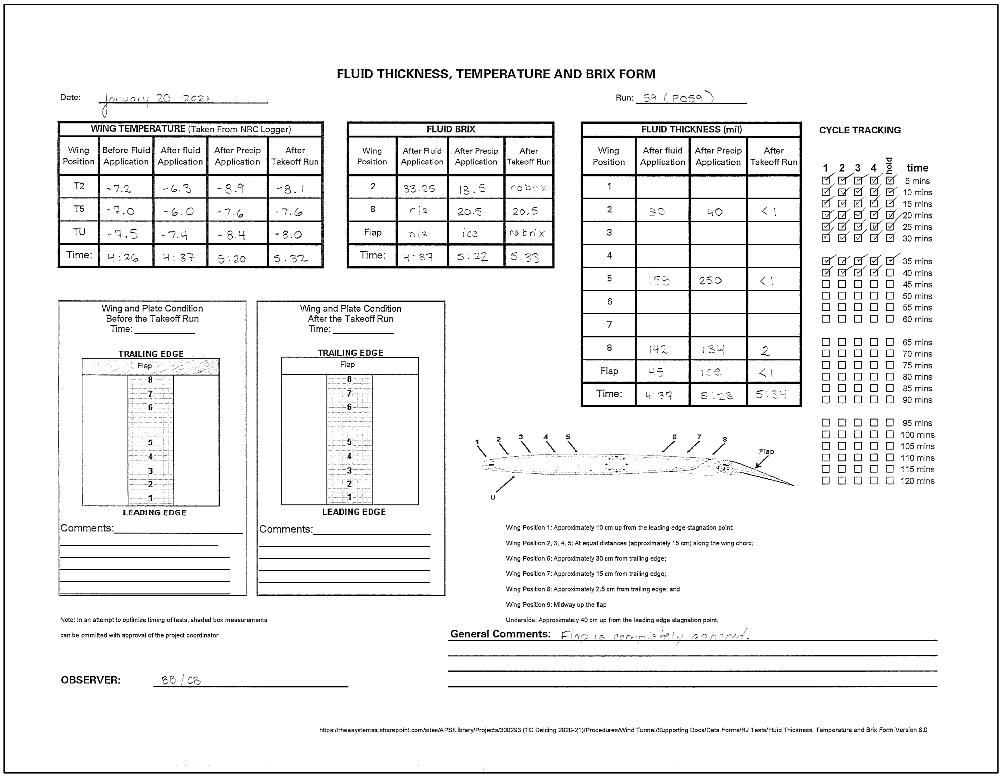
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C58: Run # 58



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20 2021

Run: 59 (P059)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.2	-6.3	-8.9	-8.1
T5	-7.0	-6.0	-7.6	-7.6
TU	-7.5	-7.4	-8.4	-8.0
Time:	4:26	4:37	5:20	5:32

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	18.5	no brix
8	n/a	20.5	20.5
Flap	n/a	ice	no brix
Time:	4:37	5:22	5:33

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	40	<1
3			
4			
5	158	250	<1
6			
7			
8	142	134	2
Flap	45	ice	<1
Time:	4:37	5:23	5:34

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Flap is completely adhered.

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

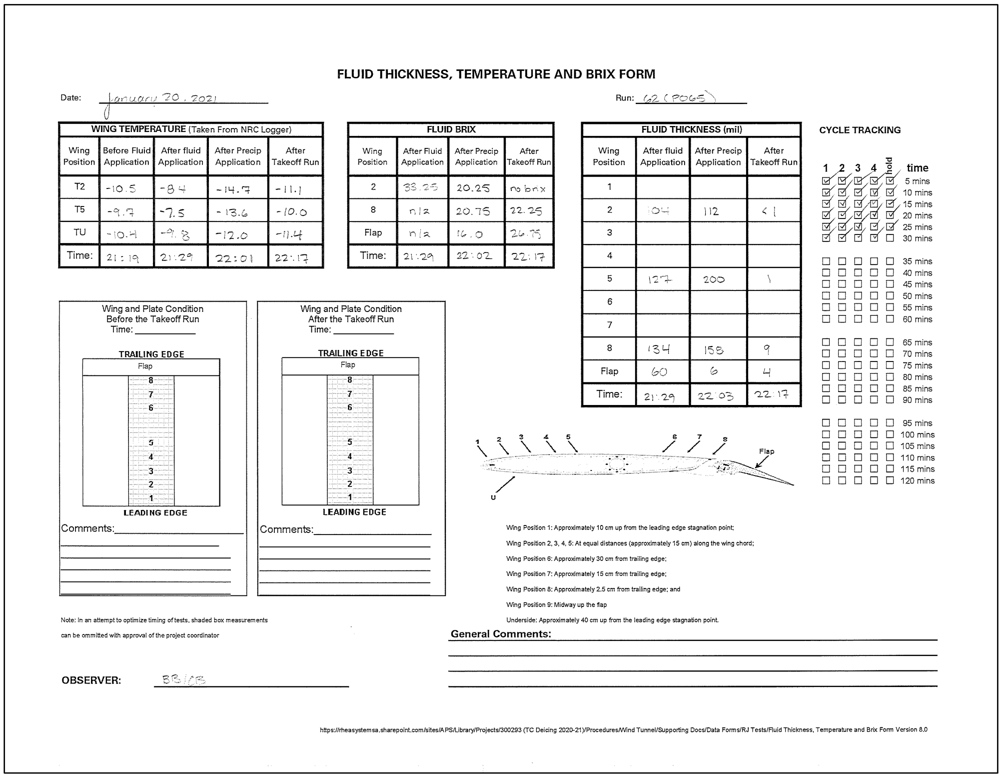
Figure C59: Run # 59

No Data Available

Figure C60: Run # 60

No Data Available

Figure C61: Run # 61



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2021

Run: 62 (P065)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.5	-8.4	-14.7	-11.1
T5	-9.7	-7.5	-13.6	-10.0
TU	-10.4	-9.8	-12.0	-11.4
Time:	21:19	21:29	22:01	22:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	20.25	no brix
8	n/a	20.75	22.25
Flap	n/a	16.0	26.75
Time:	21:29	22:02	22:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	112	<1
3			
4			
5	127	200	1
6			
7			
8	134	158	9
Flap	60	6	4
Time:	21:29	22:03	22:17

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

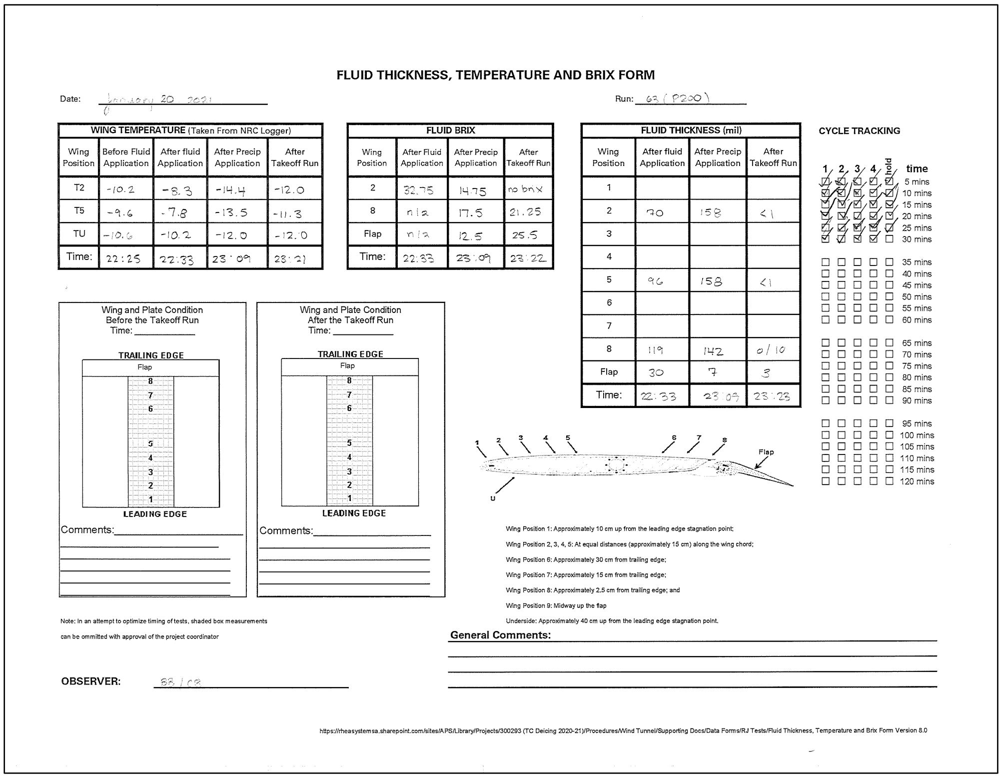
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C62: Run # 62



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20 2021

Run: 63 (P200)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.2	-8.3	-14.4	-12.0
T5	-9.6	-7.8	-13.5	-11.3
TU	-10.6	-10.2	-12.0	-12.0
Time:	22:25	22:33	23:09	23:21

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	14.75	no brix
8	n/a	17.5	21.25
Flap	n/a	12.5	25.5
Time:	22:33	23:09	23:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	158	<1
3			
4			
5	96	158	<1
6			
7			
8	119	142	0/10
Flap	30	7	3
Time:	22:33	23:09	23:23

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ______

Wing and Plate Condition After the Takeoff Run
Time: ______

Comments:

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

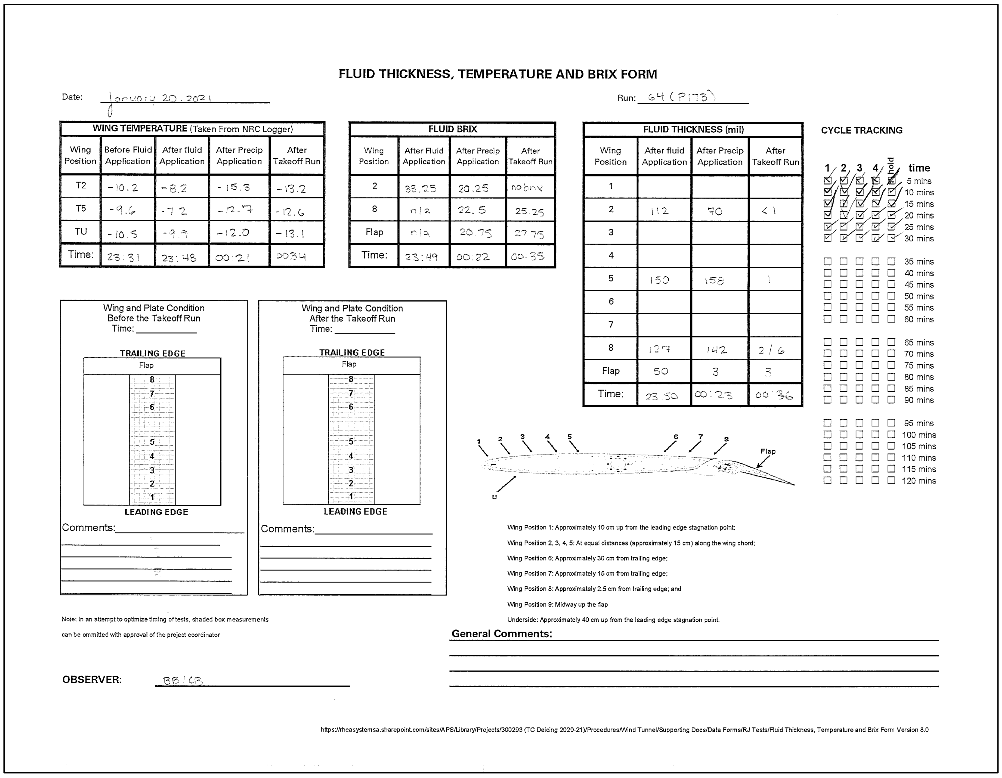
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C63: Run # 63



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20. 2021

Run: 64 (P173)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.2	-8.2	-15.3	-13.2
T5	-9.6	-7.2	-12.7	-12.6
TU	-10.5	-9.9	-12.0	-13.1
Time:	23:31	23:48	00:21	0034

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	20.25	no brix
8	n/a	22.5	25.25
Flap	n/a	20.75	27.75
Time:	23:49	00:22	00:35

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	70	<1
3			
4			
5	150	158	1
6			
7			
8	127	142	2/6
Flap	50	3	3
Time:	23:50	00:23	00:36

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ______

Wing and Plate Condition After the Takeoff Run
Time: ______

Comments:

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

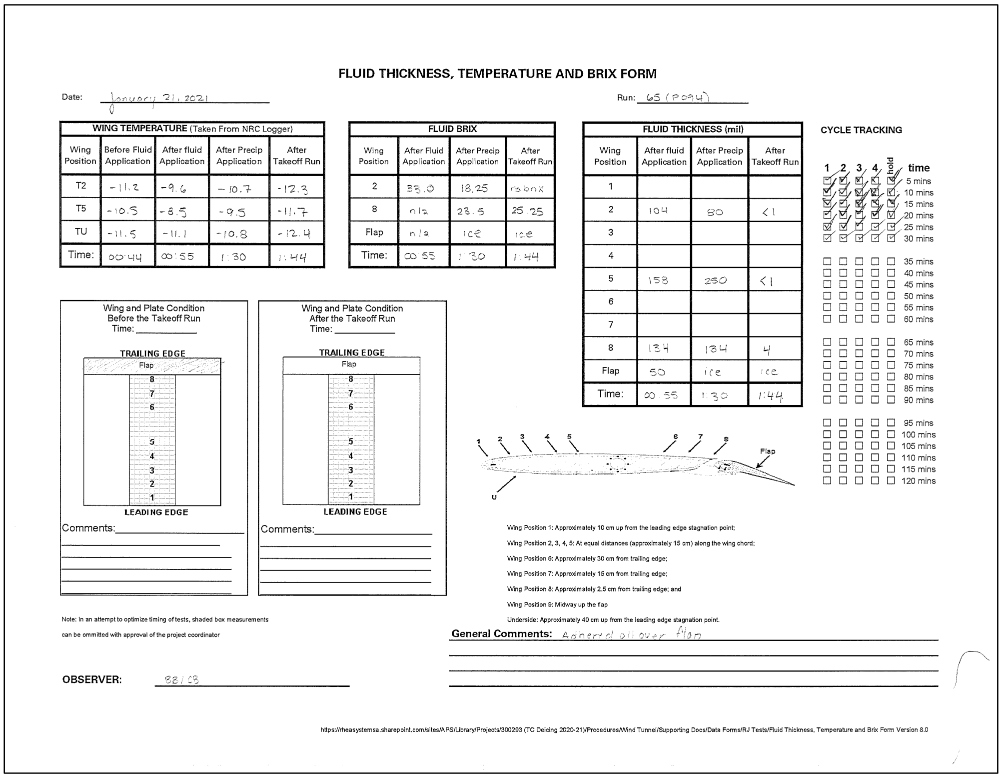
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C64: Run # 64



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 65 (P094)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.2	-9.6	-10.7	-12.3
T5	-10.5	-8.5	-9.5	-11.7
TU	-11.5	-11.1	-10.8	-12.4
Time:	00:44	00:55	1:30	1:44

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	18.25	no brix
8	n/a	23.5	25.25
Flap	n/a	ice	ice
Time:	00:55	1:30	1:44

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	80	<1
3			
4			
5	158	250	<1
6			
7			
8	134	134	4
Flap	50	ice	ice
Time:	00:55	1:30	1:44

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

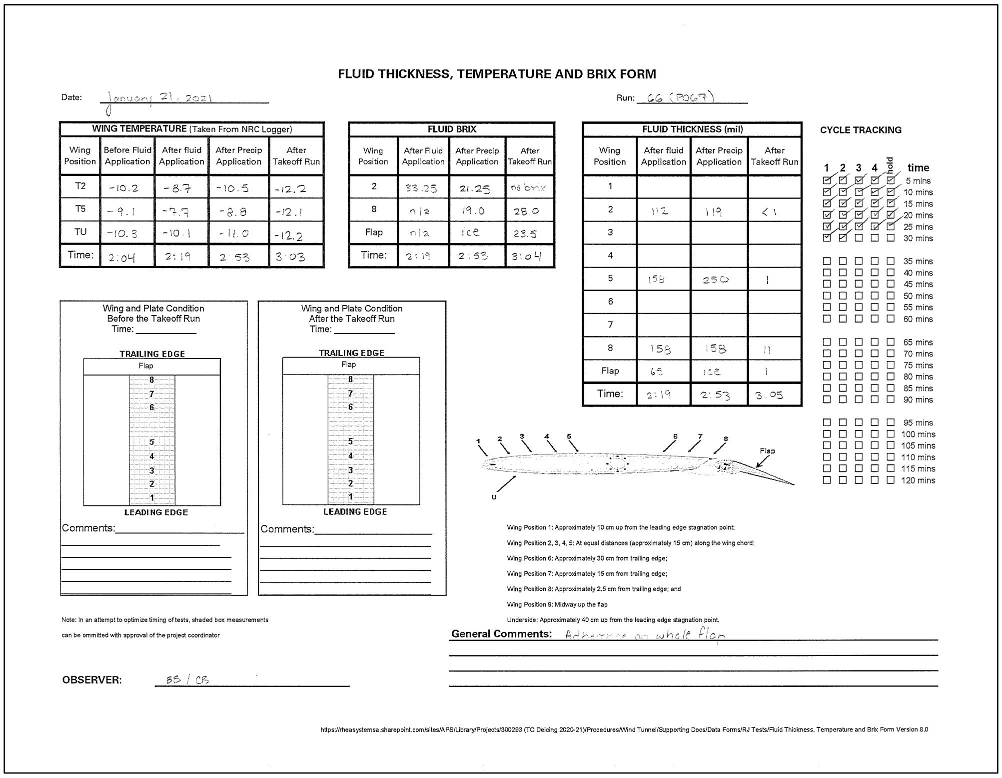
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adhered all over flap

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C65: Run # 65



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 66 (P067)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.2	-8.7	-10.5	-12.2
T5	-9.1	-7.9	-8.8	-12.1
TU	-10.3	-10.1	-11.0	-12.2
Time:	2:04	2:19	2:53	3:03

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	21.25	no brix
8	n/a	19.0	28.0
Flap	n/a	ice	23.5
Time:	2:19	2:53	3:04

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	119	<1
3			
4			
5	158	250	1
6			
7			
8	158	158	11
Flap	65	ice	1
Time:	2:19	2:53	3.05

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

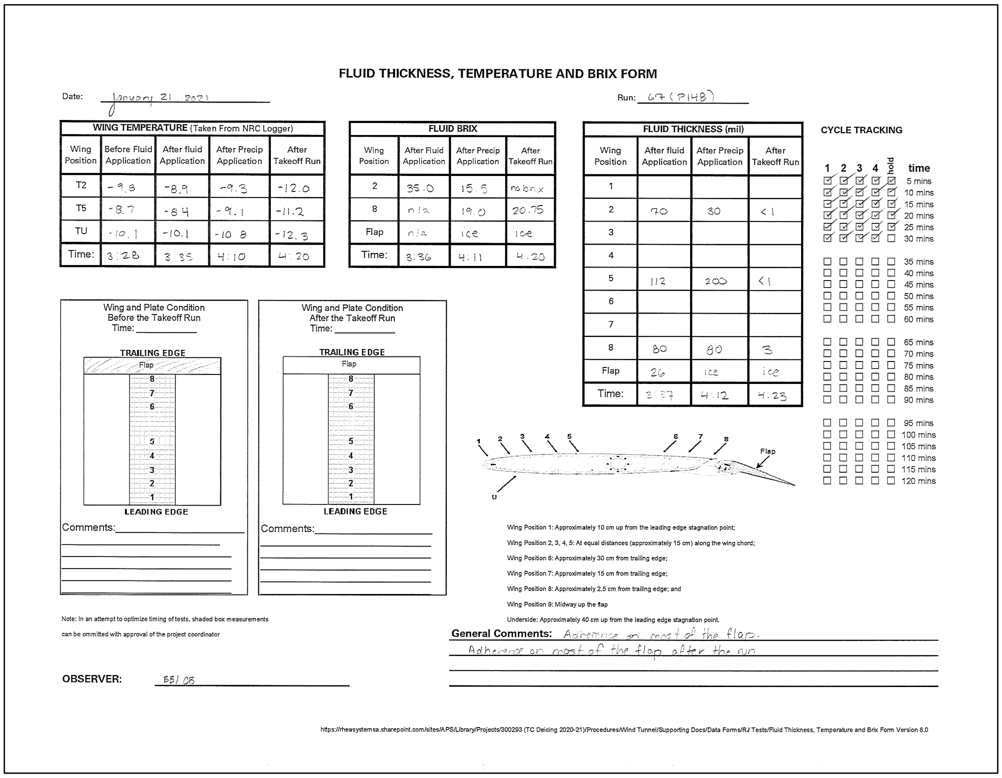
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence on whole flap

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C66: Run # 66



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 67 (P148)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.8	-8.9	-9.3	-12.0
T5	-8.7	-8.4	-9.1	-11.2
TU	-10.1	-10.1	-10.8	-12.3
Time:	3:28	3:35	4:10	4:20

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	15.5	no brix
8	n/a	19.0	20.75
Flap	n/a	ice	ice
Time:	3:36	4:11	4:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	30	<1
3			
4			
5	112	200	<1
6			
7			
8	80	80	3
Flap	26	ice	ice
Time:	3:37	4:12	4:23

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

1 2 3 4 5 6 7 8 Flap U

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

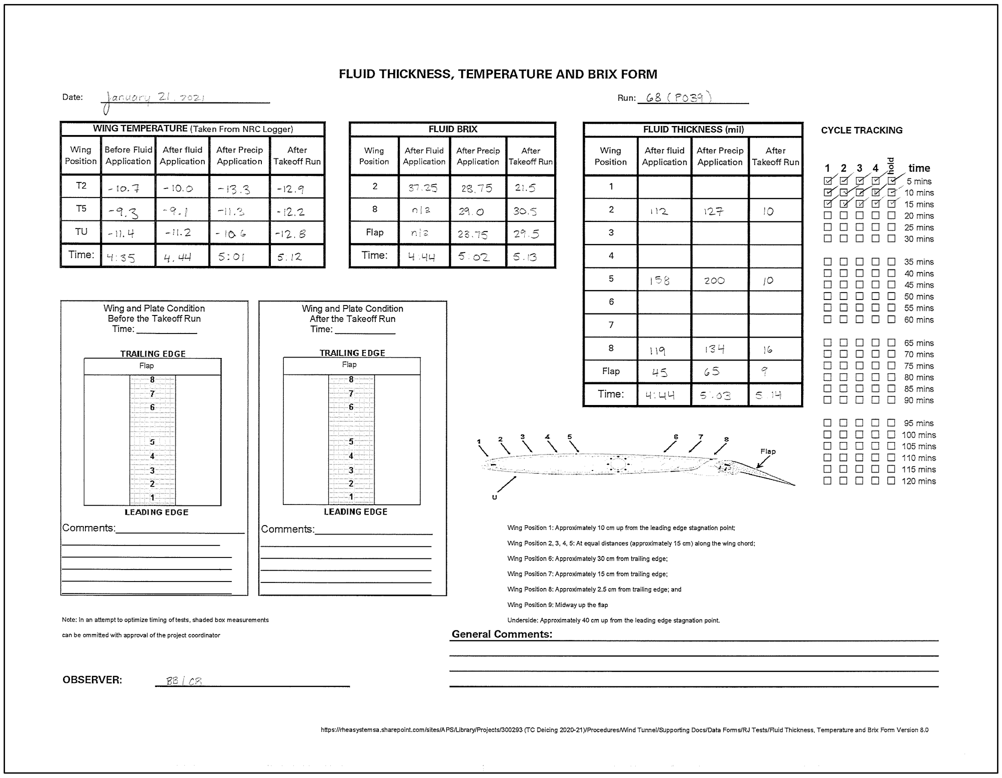
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence on most of the flap.
Adherence on most of the flap after the run

OBSERVER: BB/ CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C67: Run # 67



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 68 (P039)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.7	-10.0	-13.3	-12.9
T5	-9.3	-9.1	-11.3	-12.2
TU	-11.4	-11.2	-10.6	-12.8
Time:	4:35	4.44	5:01	5:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	28.75	21.5
8	n/a	29.0	30.5
Flap	n/a	28.75	29.5
Time:	4:44	5:02	5.13

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	127	10
3			
4			
5	158	200	10
6			
7			
8	119	134	16
Flap	45	65	9
Time:	4:44	5:03	5.14

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

1 2 3 4 5 6 7 8 Flap U

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

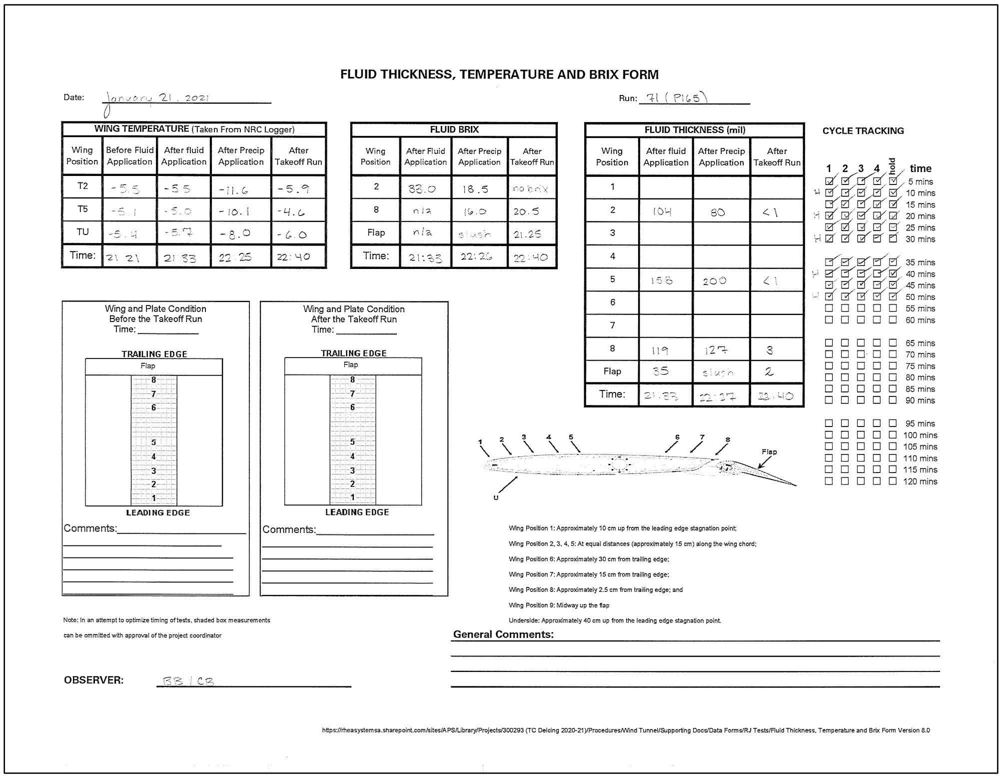
Figure C68: Run # 68

No Data Available

Figure C69: Run # 69

No Data Available

Figure C70: Run # 70



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 71 (P165)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.5	-5.5	-11.6	-5.9
T5	-5.1	-5.0	-10.1	-4.6
TU	-5.4	-5.7	-8.0	-6.0
Time:	21 21	21:33	22:25	22:40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	18.5	no brix
8	n/a	16.0	20.5
Flap	n/a	slush	21.25
Time:	21:33	22:26	22:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	80	<1
3			
4			
5	158	200	<1
6			
7			
8	119	127	3
Flap	35	slush	2
Time:	21:33	22:27	22:40

CYCLE TRACKING

	1	2	3	4	hold	time
	☑	☑	☑	☑	☑	5 mins
H	☑	☑	☑	☑	☑	10 mins
	☑	☑	☑	☑	☑	15 mins
H	☑	☑	☑	☑	☑	20 mins
	☑	☑	☑	☑	☑	25 mins
H	☑	☑	☑	☑	☑	30 mins
	☑	☑	☑	☑	☑	35 mins
H	☑	☑	☑	☑	☑	40 mins
	☑	☑	☑	☑	☑	45 mins
H	☑	☑	☑	☑	☑	50 mins
	☐	☐	☐	☐	☐	55 mins
	☐	☐	☐	☐	☐	60 mins
	☐	☐	☐	☐	☐	65 mins
	☐	☐	☐	☐	☐	70 mins
	☐	☐	☐	☐	☐	75 mins
	☐	☐	☐	☐	☐	80 mins
	☐	☐	☐	☐	☐	85 mins
	☐	☐	☐	☐	☐	90 mins
	☐	☐	☐	☐	☐	95 mins
	☐	☐	☐	☐	☐	100 mins
	☐	☐	☐	☐	☐	105 mins
	☐	☐	☐	☐	☐	110 mins
	☐	☐	☐	☐	☐	115 mins
	☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments:

Wing and Plate Condition After the Takeoff Run
Time: ___________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

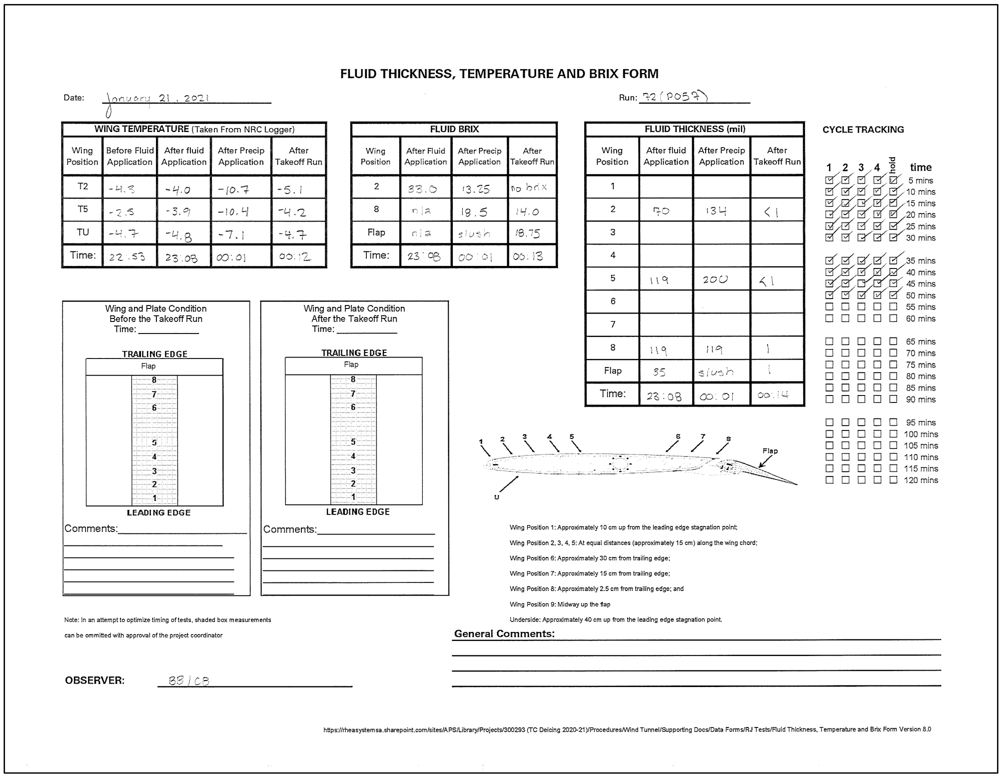
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C71: Run # 71



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2021

Run: 72 (P057)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.3	-4.0	-10.7	-5.1
T5	-2.5	-3.9	-10.4	-4.2
TU	-4.7	-4.8	-7.1	-4.7
Time:	22:53	23:08	00:01	00:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	13.25	no brix
8	n/a	18.5	14.0
Flap	n/a	slush	18.75
Time:	23:08	00:01	00:13

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	134	<1
3			
4			
5	119	200	<1
6			
7			
8	119	119	1
Flap	35	slush	1
Time:	23:08	00:01	00:14

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments:

Wing and Plate Condition After the Takeoff Run
Time: ___________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

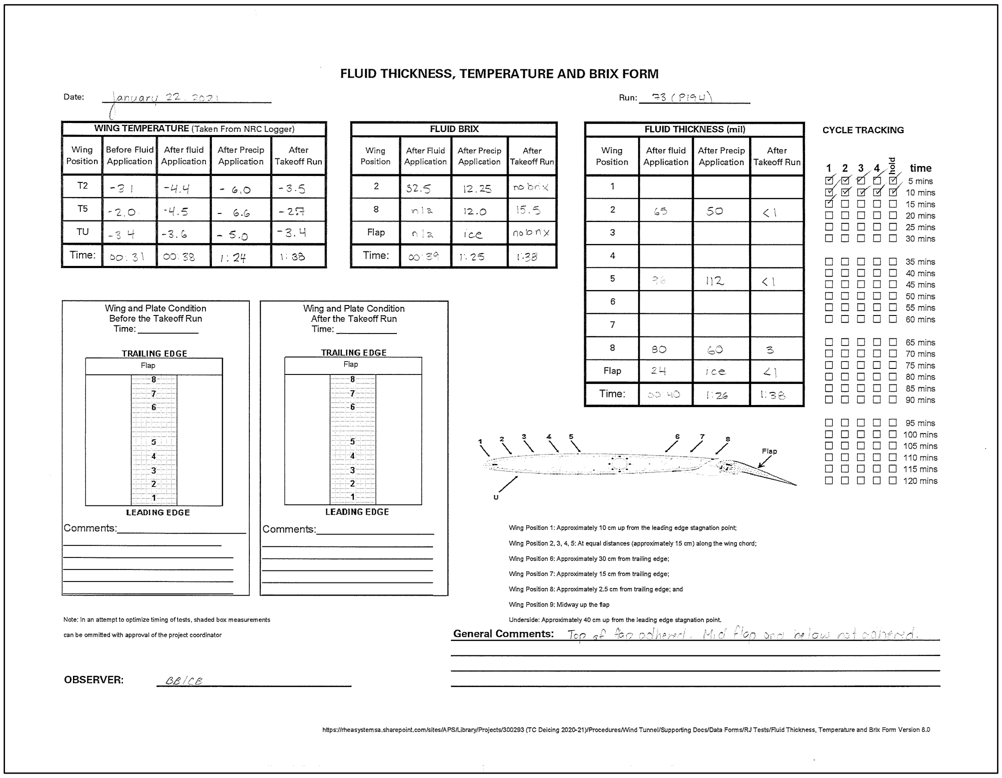
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C72: Run # 72



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 22, 2021

Run: 73 (P194)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3 1	-4.4	- 6.0	-3.5
T5	-2.0	-4.5	- 6.6	-2.7
TU	-3 4	-3.6	- 5.0	-3.4
Time:	00:31	00:38	1:24	1:38

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	12.25	no brix
8	n/a	12.0	15.5
Flap	n/a	ice	no brix
Time:	00:39	1:25	1:38

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	50	<1
3			
4			
5	96	112	<1
6			
7			
8	80	60	3
Flap	24	ice	<1
Time:	00:40	1:26	1:38

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☐	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

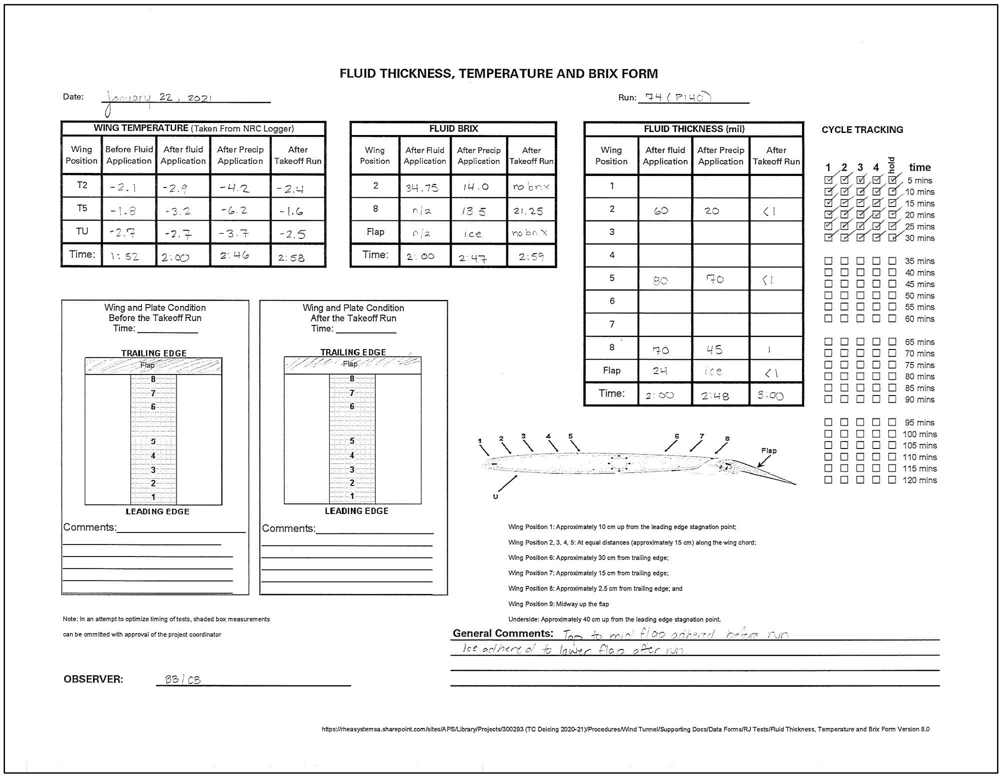
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Top of flap adhered. Mid flap and below not adhered.

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C73: Run # 73



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 22, 2021

Run: 74 (P140)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-2.1	-2.9	-4.2	-2.4
T5	-1.8	-3.2	-6.2	-1.6
TU	-2.7	-2.7	-3.7	-2.5
Time:	1:52	2:00	2:46	2:58

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	14.0	no brix
8	n/a	13.5	21.25
Flap	n/a	ice	no brix
Time:	2:00	2:47	2:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	20	<1
3			
4			
5	80	70	<1
6			
7			
8	70	45	1
Flap	24	ice	<1
Time:	2:00	2:48	3:00

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

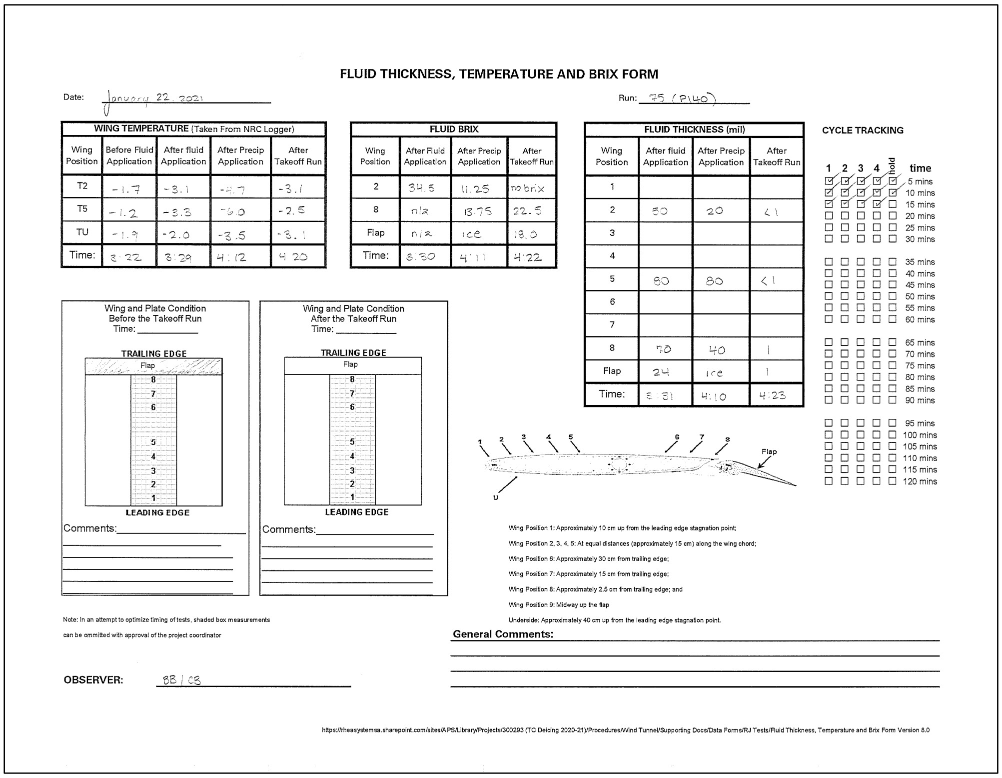
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Top to mid flap adhered before run
Ice adhered to lower flap after run.

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C74: Run # 74



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 22, 2021

Run: 75 (P140)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.7	-3.1	-4.7	-3.1
T5	-1.2	-3.3	-6.0	-2.5
TU	-1.9	-2.0	-3.5	-3.1
Time:	3:22	3:29	4:12	4:20

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	11.25	no brix
8	n/a	13.75	22.5
Flap	n/a	ice	18.0
Time:	3:30	4:11	4:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	50	20	<1
3			
4			
5	80	80	<1
6			
7			
8	70	40	1
Flap	24	ice	1
Time:	3:31	4:10	4:23

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
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☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

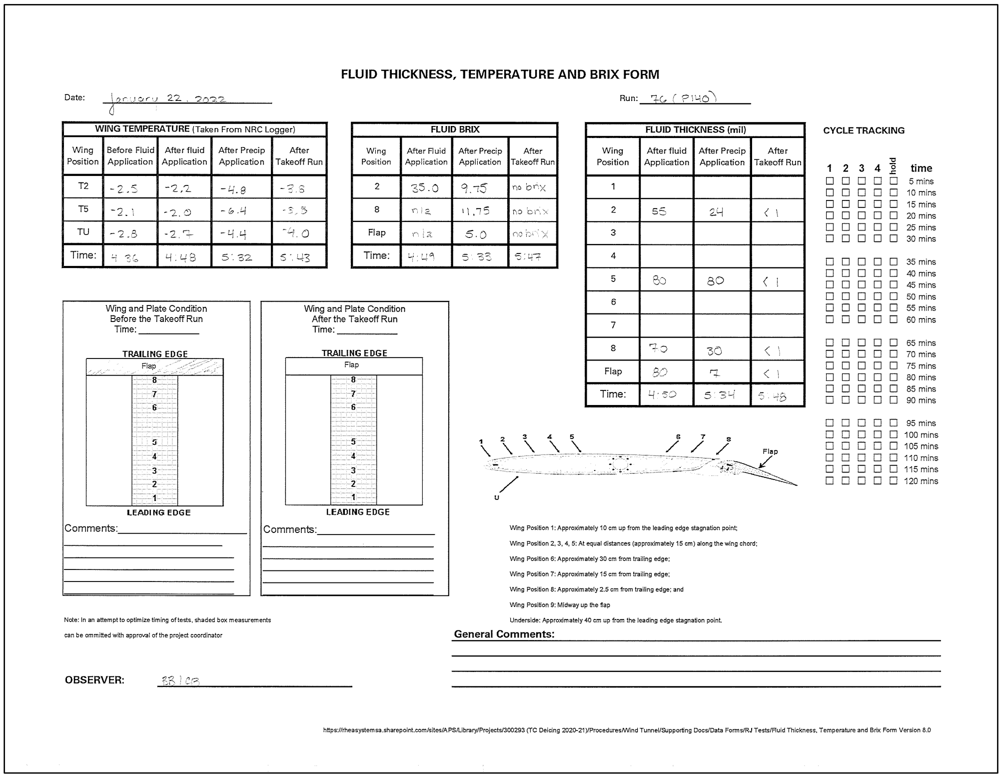
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C75: Run # 75



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 22, 2022

Run: 76 (P140)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-2.5	-2.2	-4.8	-3.8
T5	-2.1	-2.0	-6.4	-3.3
TU	-2.8	-2.7	-4.4	-4.0
Time:	4 36	4:48	5:32	5:43

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	9.75	no brix
8	n/a	11.75	no brix
Flap	n/a	5.0	no brix
Time:	4:49	5:33	5:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	24	<1
3			
4			
5	80	80	<1
6			
7			
8	70	30	<1
Flap	80	7	<1
Time:	4:50	5:34	5:48

CYCLE TRACKING

1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

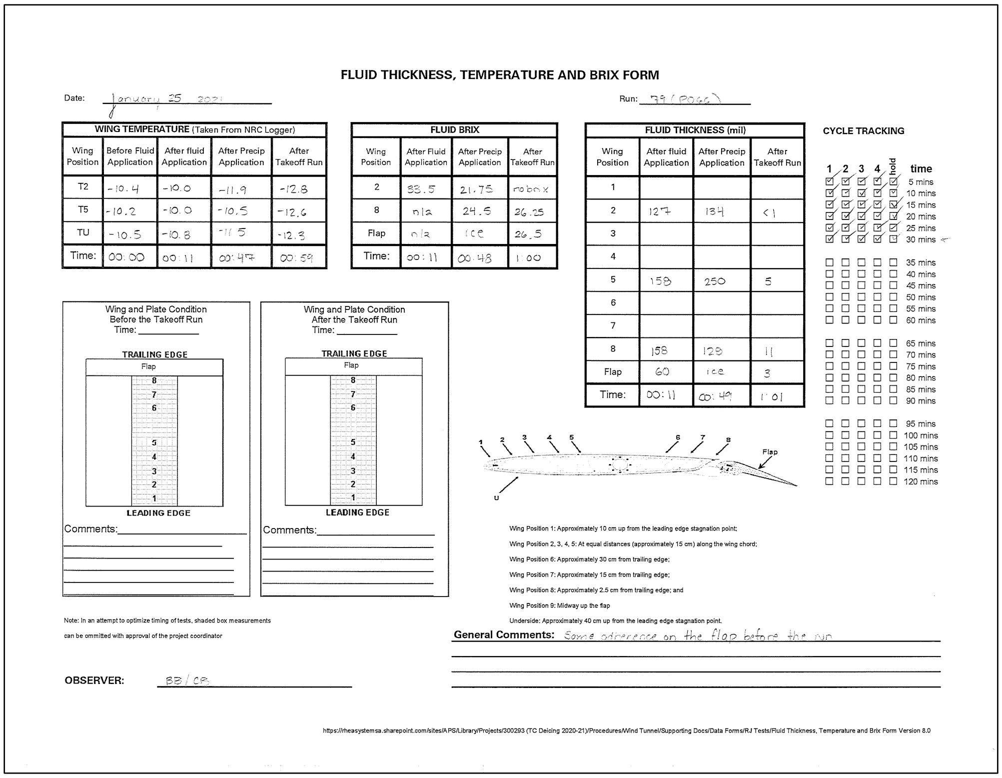
Figure C76: Run # 76

No Data Available

Figure C77: Run # 77

No Data Available

Figure C78: Run # 78



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25 2021

Run: 79 (P066)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.4	-10.0	-11.9	-12.8
T5	-10.2	-10.0	-10.5	-12.6
TU	-10.5	-10.8	-11.5	-12.3
Time:	00:00	00:11	00:47	00:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	21.75	no brix
8	n/a	24.5	26.25
Flap	n/a	ice	26.5
Time:	00:11	00:48	1:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	134	<1
3			
4			
5	158	250	5
6			
7			
8	158	128	11
Flap	60	ice	3
Time:	00:11	00:49	1:01

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins ←
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

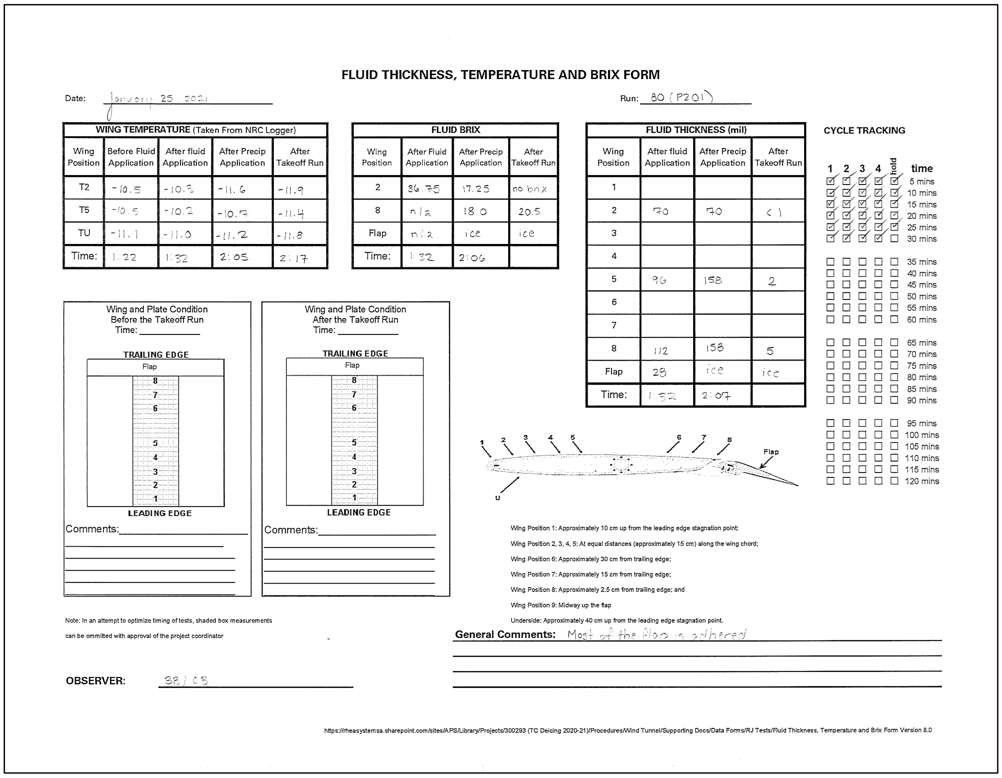
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Some adherence on the flap before the run

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C79: Run # 79



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 80 (P201)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.5	-10.3	-11.6	-11.9
T5	-10.5	-10.2	-10.7	-11.4
TU	-11.1	-11.0	-11.2	-11.8
Time:	1:22	1:32	2:05	2:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	17.25	no brix
8	n/a	18.0	20.5
Flap	n/a	ice	ice
Time:	1:32	2:06	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	70	<1
3			
4			
5	96	158	2
6			
7			
8	112	158	5
Flap	28	ice	ice
Time:	1:32	2:07	

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

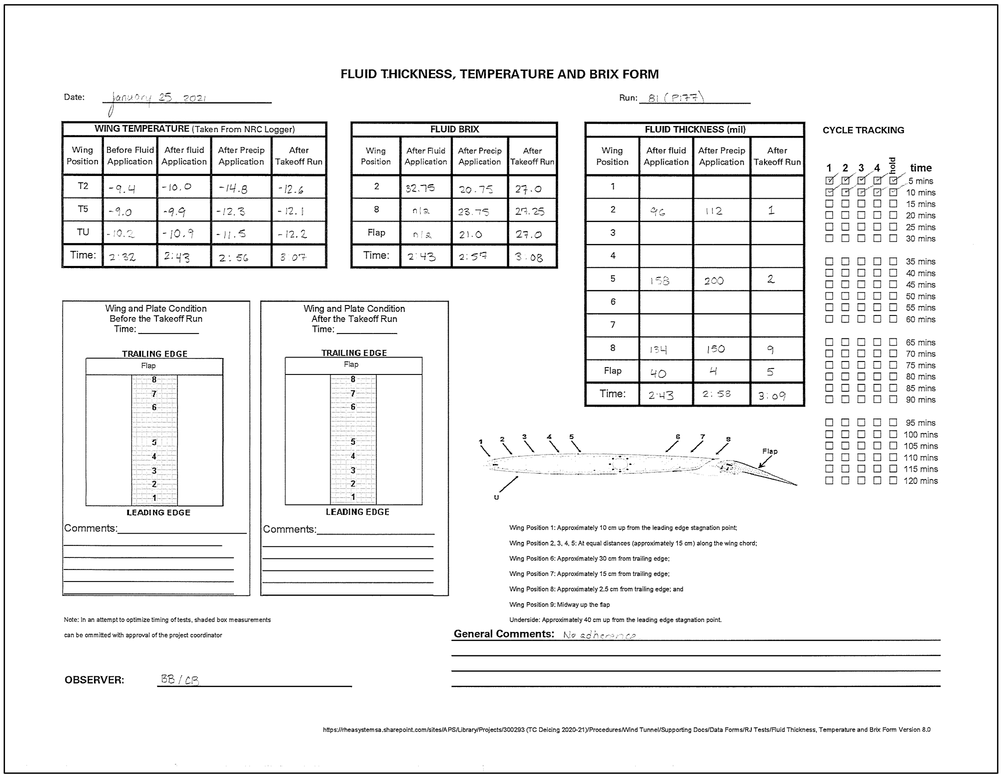
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Most of the flap is adhered

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C80: Run # 80



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 81 (P177)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.4	-10.0	-14.8	-12.6
T5	-9.0	-9.9	-12.3	-12.1
TU	-10.2	-10.9	-11.5	-12.2
Time:	2:32	2:43	2:56	3:07

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	20.75	27.0
8	n/a	23.75	27.25
Flap	n/a	21.0	27.0
Time:	2:43	2:57	3:08

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	112	1
3			
4			
5	158	200	2
6			
7			
8	134	150	9
Flap	40	4	5
Time:	2:43	2:58	3:09

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

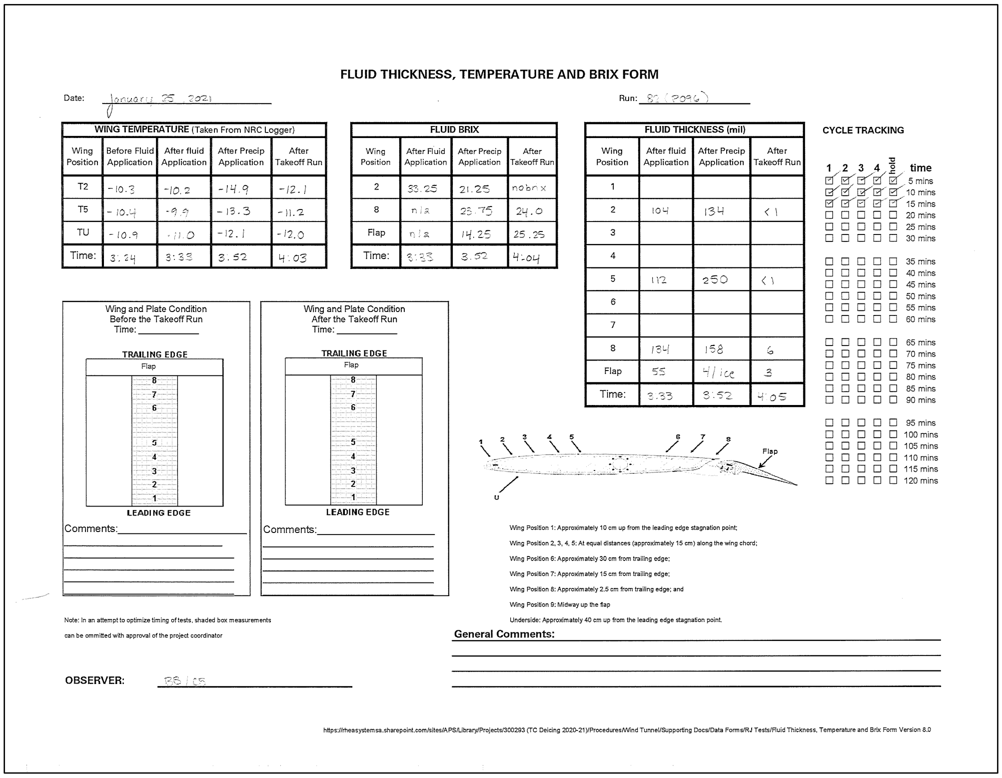
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C81: Run # 81



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 82 (P096)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.3	-10.2	-14.9	-12.1
T5	-10.4	-9.9	-13.3	-11.2
TU	-10.9	-11.0	-12.1	-12.0
Time:	3:24	3:33	3:52	4:03

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	21.25	nobrix
8	n/a	23.75	24.0
Flap	n/a	14.25	25.25
Time:	3:33	3.52	4:04

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	134	<1
3			
4			
5	112	250	<1
6			
7			
8	134	158	6
Flap	55	4/ice	3
Time:	3:33	3:52	4:05

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

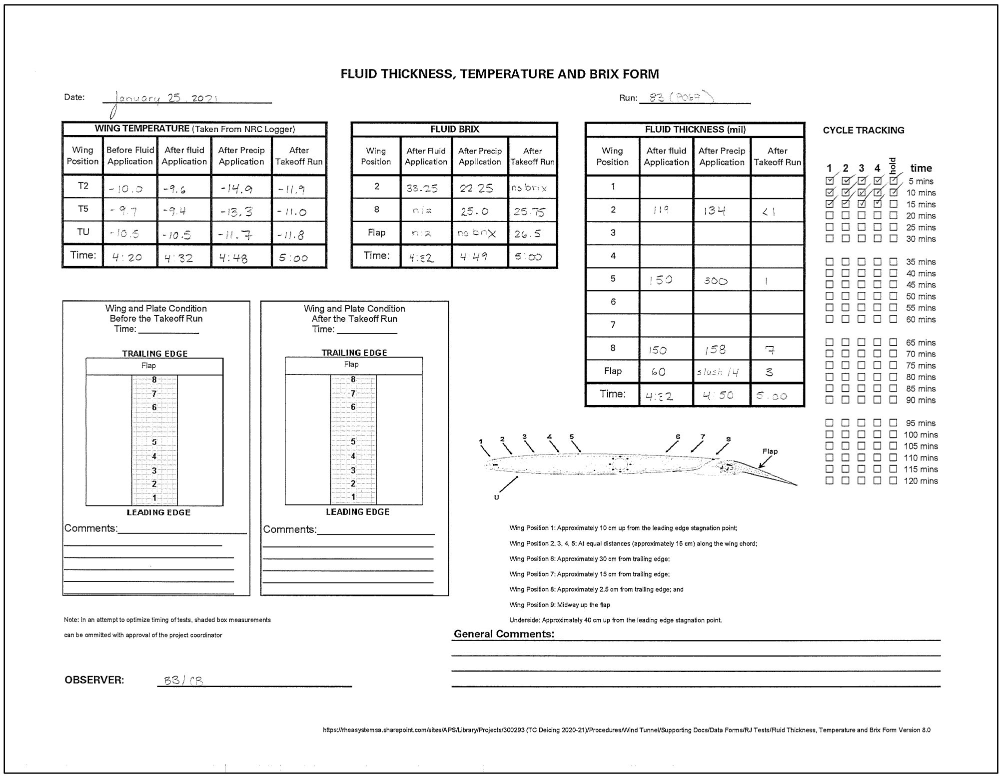
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C82: Run # 82



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 83 (P069)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.0	-9.6	-14.9	-11.9
T5	-9.7	-9.4	-13.3	-11.0
TU	-10.5	-10.5	-11.7	-11.8
Time:	4:20	4:32	4:48	5:00

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	22.25	no brix
8	n/a	25.0	25.75
Flap	n/a	no brix	26.5
Time:	4:32	4:49	5:00

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	134	<1
3			
4			
5	150	300	1
6			
7			
8	150	158	7
Flap	60	slush /4	3
Time:	4:32	4:50	5:00

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

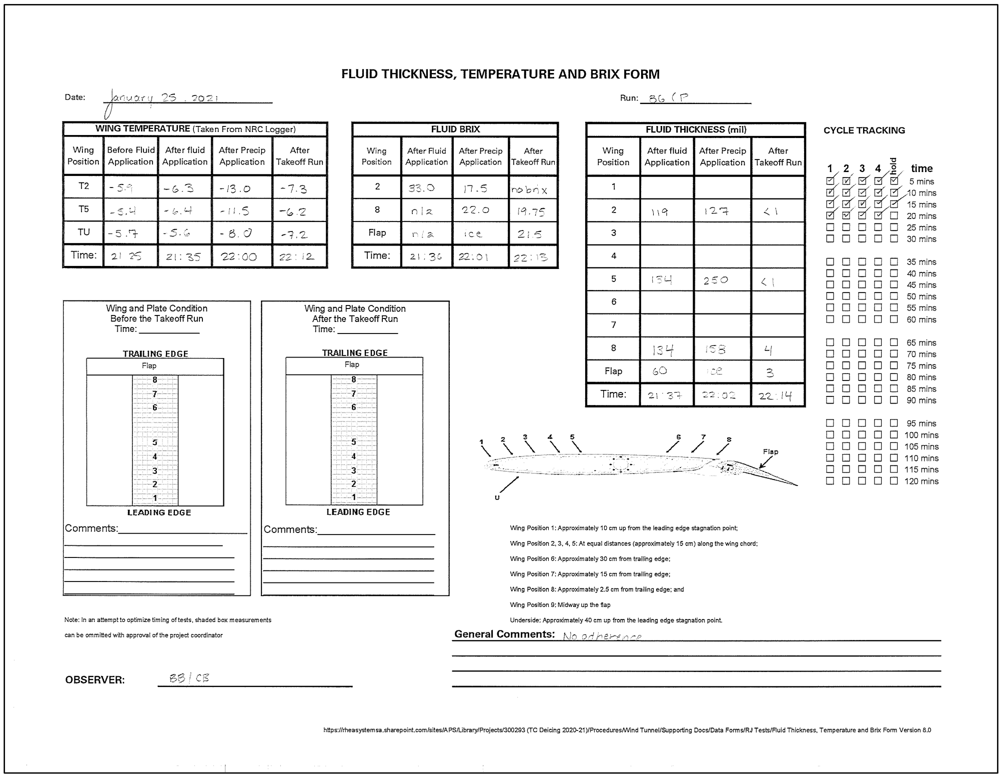
Figure C83: Run # 83

No Data Available

Figure C84: Run # 84

No Data Available

Figure C85: Run # 85



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 86 (P

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.9	-6.3	-13.0	-7.3
T5	-5.4	-6.4	-11.5	-6.2
TU	-5.7	-5.6	-8.0	-7.2
Time:	21 25	21:35	22:00	22:12

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	17.5	no brix
8	n/a	22.0	19.75
Flap	n/a	ice	21.5
Time:	21:36	22:01	22:13

FLUID THICKNESS (mil)

Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	127	<1
3			
4			
5	134	250	<1
6			
7			
8	134	158	4
Flap	60	ice	3
Time:	21:37	22:02	22:14

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

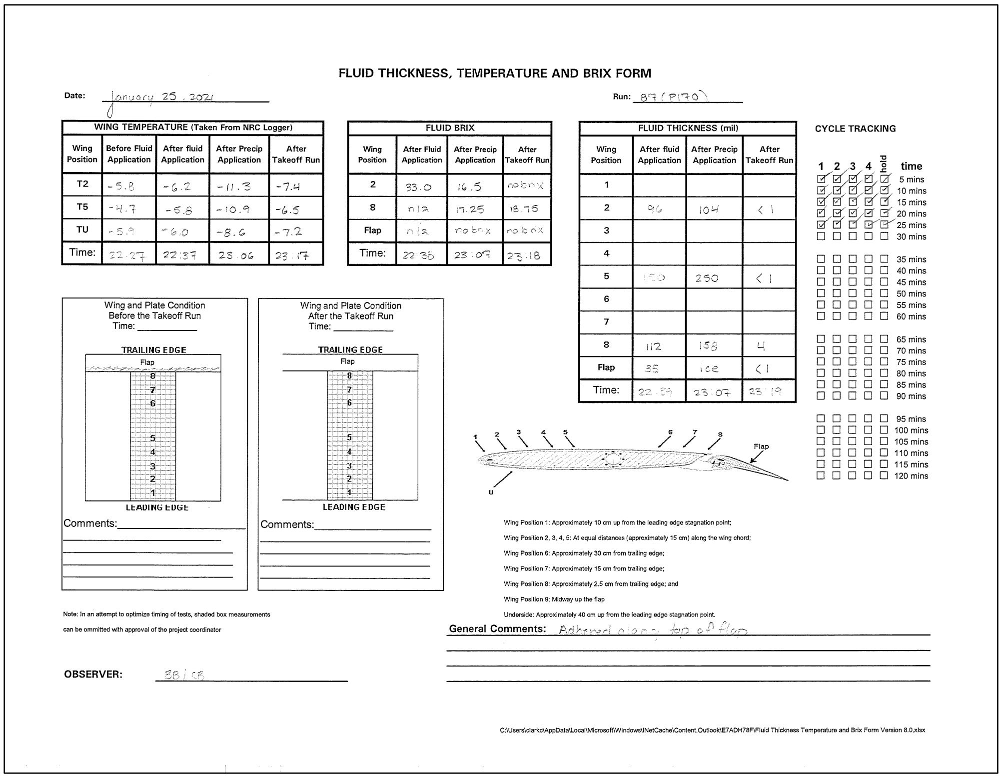
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2020-21)/Procedures/Wind Tunnel/Supporting Docs/Data Forms/RJ Tests/Fluid Thickness, Temperature and Brix Form Version 8.0

Figure C86: Run # 86



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 87 (P170)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.8	-6.2	-11.3	-7.4
T5	-4.7	-5.8	-10.9	-6.5
TU	-5.9	-6.0	-8.6	-7.2
Time:	22:27	22:37	23:06	23:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	16.5	no brix
8	n/a	17.25	18.75
Flap	n/a	no brix	no brix
Time:	22:38	23:07	23:18

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	104	< 1
3			
4			
5	150	250	< 1
6			
7			
8	112	158	4
Flap	35	ice	< 1
Time:	22:39	23:07	23:19

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adhered along top of flap

OBSERVER: BB / CB

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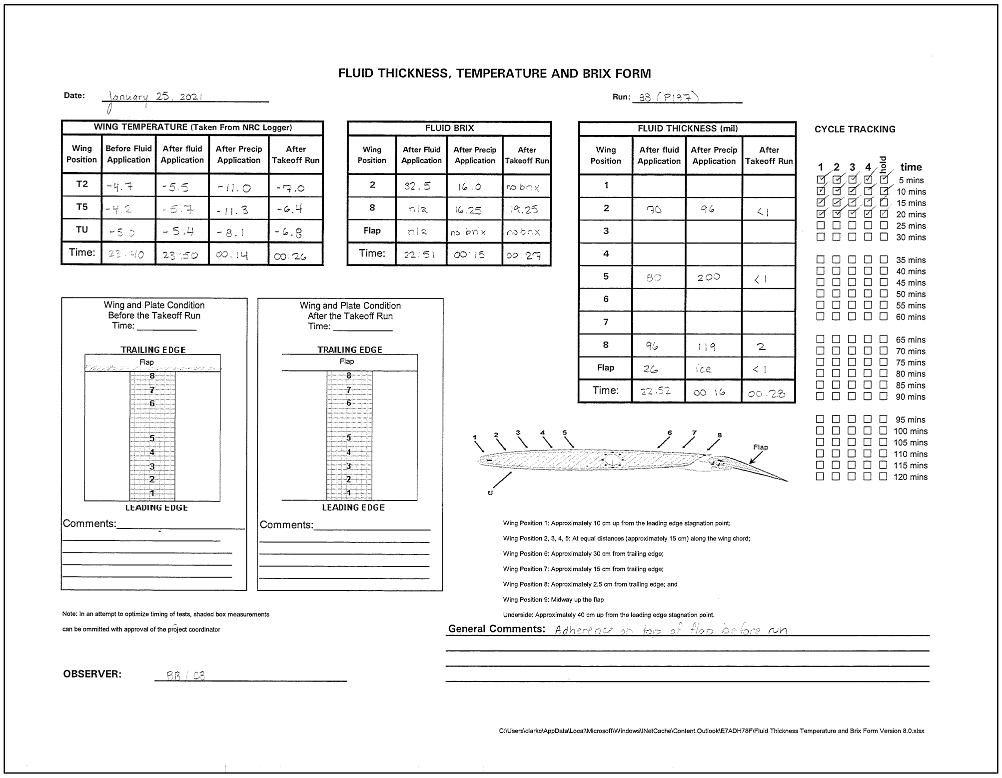
Figure C87: Run # 87



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2021

Run: 88 (P197)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.7	-5.5	-11.0	-7.0
T5	-4.2	-5.7	-11.3	-6.4
TU	-5.0	-5.4	-8.1	-6.8
Time:	23:40	23:50	00:14	00:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	16.0	no brix
8	n/a	16.25	19.25
Flap	n/a	no brix	no brix
Time:	22:51	00:15	00:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	96	<1
3			
4			
5	80	200	<1
6			
7			
8	96	119	2
Flap	26	ice	<1
Time:	22:52	00:16	00:28

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence on top of flap before run

OBSERVER: BB / CB

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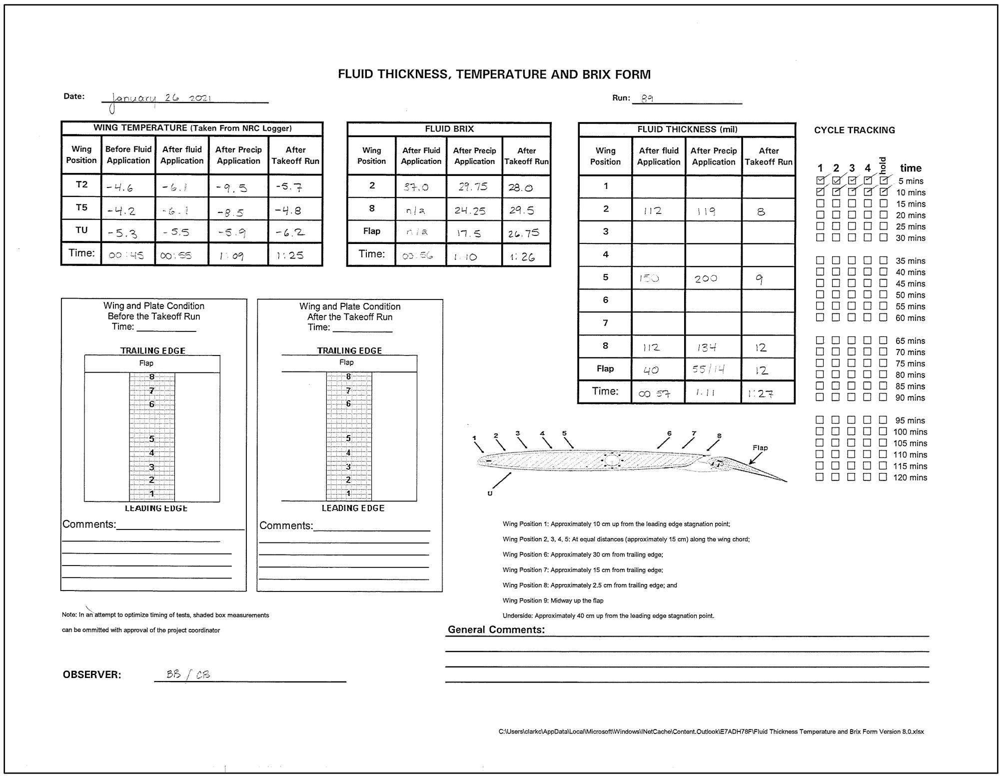
Figure C88: Run # 88



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26 2021

Run: 89

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.6	-6.1	-9.5	-5.7
T5	-4.2	-6.1	-8.5	-4.8
TU	-5.3	-5.5	-5.9	-6.2
Time:	00:45	00:55	1:09	1:25

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	29.75	28.0
8	n/a	24.25	29.5
Flap	n/a	17.5	26.75
Time:	00:56	1:10	1:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	119	8
3			
4			
5	150	200	9
6			
7			
8	112	134	12
Flap	40	55/14	12
Time:	00:57	1:11	1:27

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:___________________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:___________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________________

OBSERVER: BB / CB

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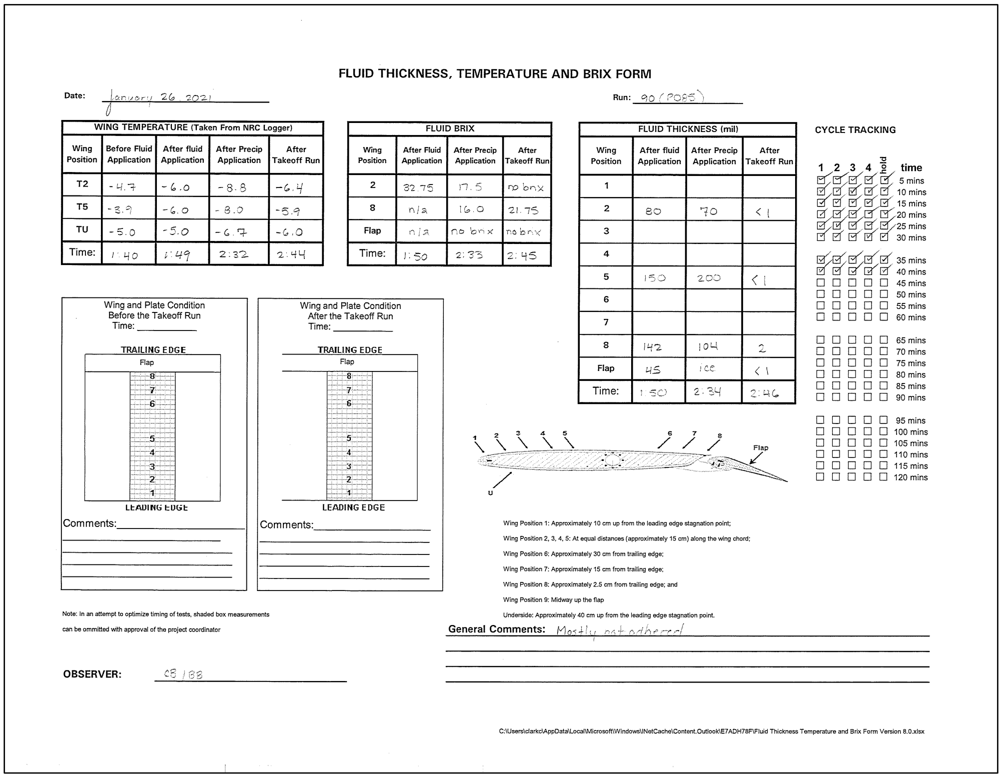
Figure C89: Run # 89



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26 2021

Run: 90 (PO85)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.7	-6.0	-8.8	-6.4
T5	-3.9	-6.0	-8.0	-5.9
TU	-5.0	-5.0	-6.7	-6.0
Time:	1:40	1:49	2:32	2:44

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	17.5	no brix
8	n/a	16.0	21.75
Flap	n/a	no brix	no brix
Time:	1:50	2:33	2:45

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	70	<1
3			
4			
5	150	200	<1
6			
7			
8	142	104	2
Flap	45	ice	<1
Time:	1:50	2:34	2:46

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:___________________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:___________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Mostly not adhered

OBSERVER: CB / BB

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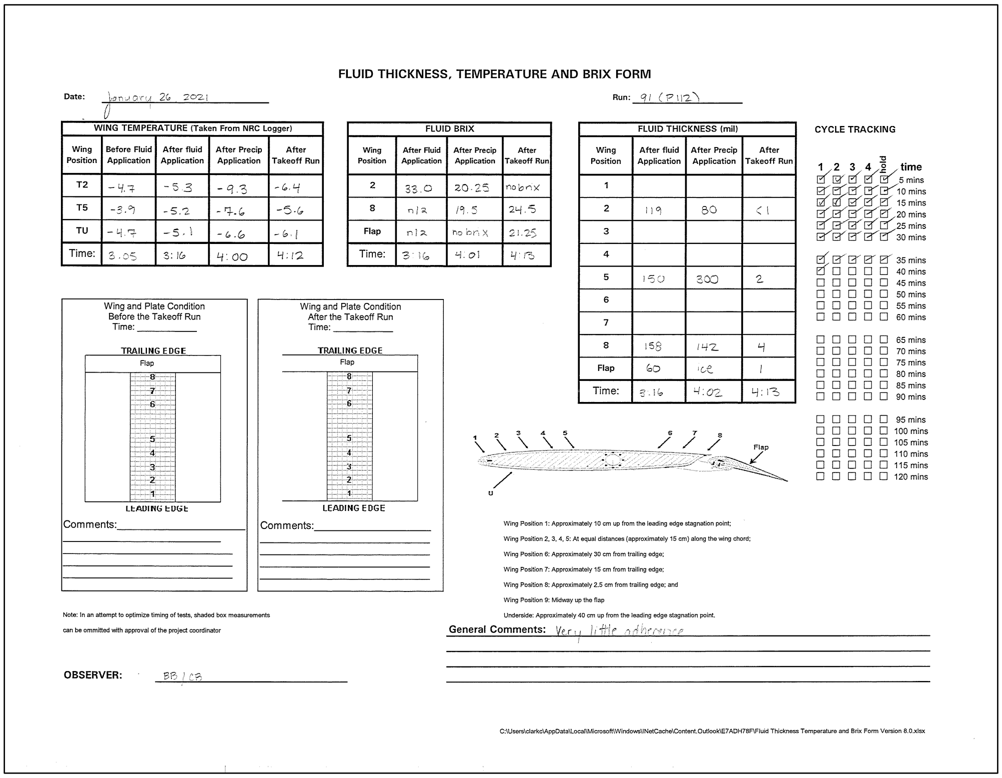
Figure C90: Run # 90



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26 2021

Run: 91 (P112)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.7	-5.3	-9.3	-6.4
T5	-3.9	-5.2	-7.6	-5.6
TU	-4.7	-5.1	-6.6	-6.1
Time:	3.05	3:16	4:00	4:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	20.25	no brix
8	n/a	19.5	24.5
Flap	n/a	no brix	21.25
Time:	3:16	4:01	4:13

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	80	<1
3			
4			
5	150	300	2
6			
7			
8	158	142	4
Flap	60	ice	1
Time:	3:16	4:02	4:13

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

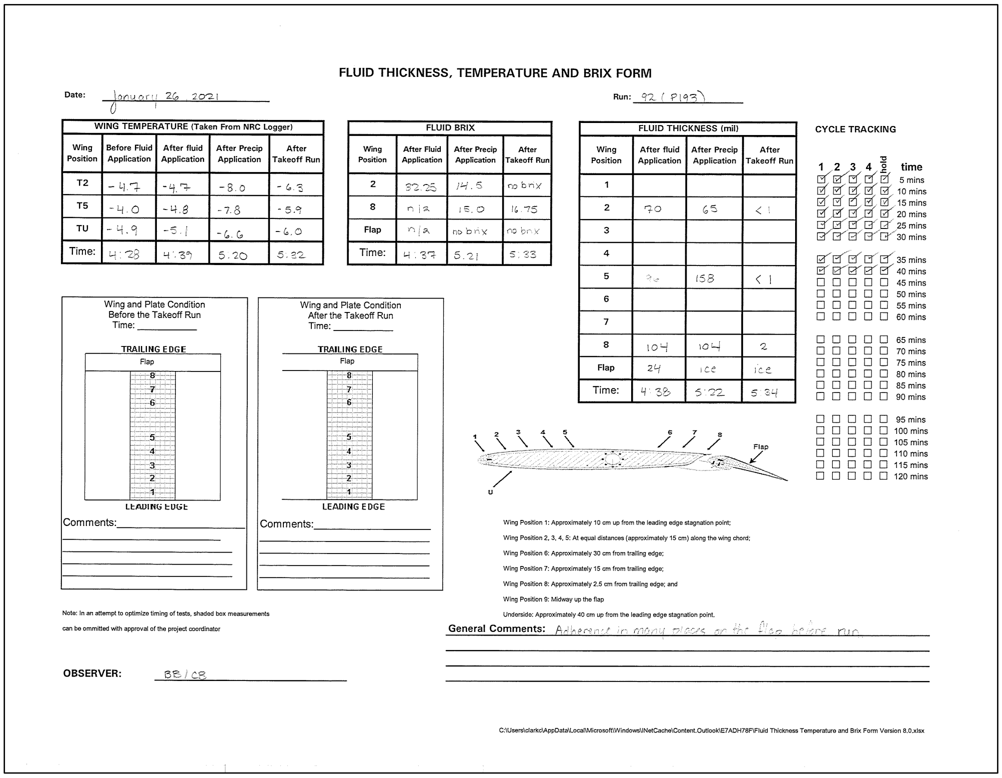
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Very little adherence

OBSERVER: BB / CB

C:\Users\clarkc\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\E7ADH78F\Fluid Thickness Temperature and Brix Form Version 8.0.xlsx

Figure C91: Run # 91



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2021

Run: 92 (P193)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.7	-4.7	-8.0	-6.3
T5	-4.0	-4.8	-7.8	-5.9
TU	-4.9	-5.1	-6.6	-6.0
Time:	4:28	4:39	5:20	5:32

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.25	14.5	no brix
8	n/a	15.0	16.75
Flap	n/a	no brix	no brix
Time:	4:37	5.21	5:33

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	65	<1
3			
4			
5	96	158	<1
6			
7			
8	104	104	2
Flap	24	ice	ice
Time:	4:38	5:22	5:34

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Adherence in many places on the flap before run

OBSERVER: BB / CB

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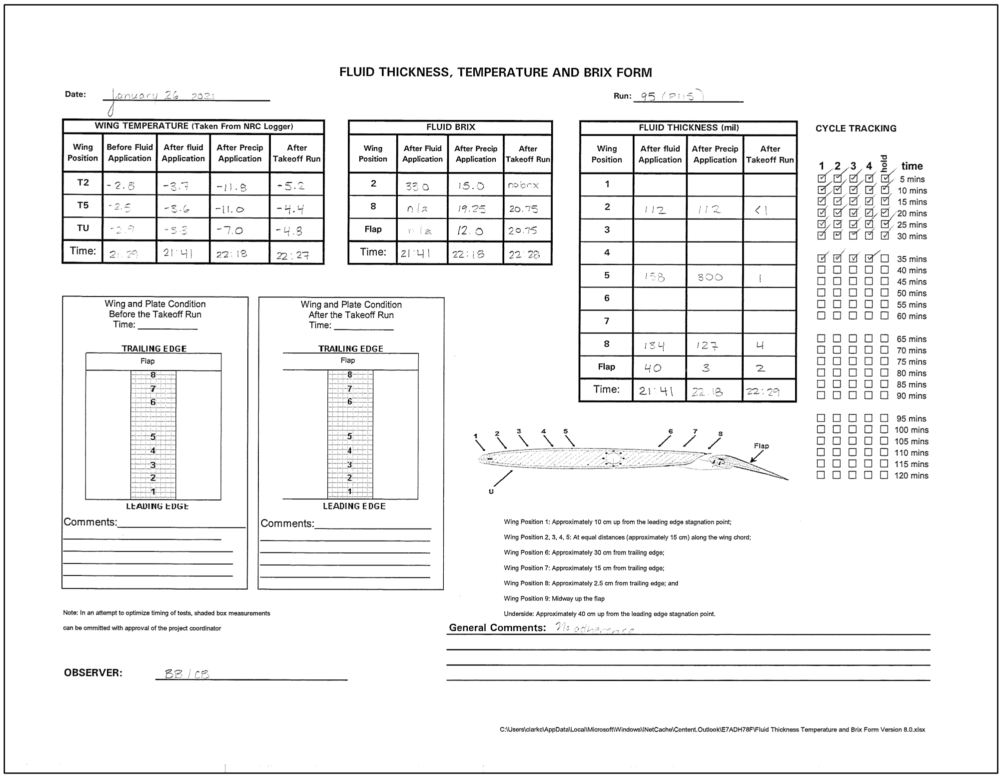
Figure C92: Run # 92

No Data Available

Figure C93: Run # 93

No Data Available

Figure C94: Run # 94



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26 2021

Run: 95 (P115)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-2.8	-3.7	-11.8	-5.2
T5	-2.5	-3.6	-11.0	-4.4
TU	-2.9	-3.3	-7.0	-4.8
Time:	21:29	21:41	22:18	22:27

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	15.0	no brix
8	n/a	19.25	20.75
Flap	n/a	12.0	20.75
Time:	21:41	22:18	22:28

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	112	<1
3			
4			
5	158	300	1
6			
7			
8	134	127	4
Flap	40	3	2
Time:	21:41	22:18	22:29

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
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☑	☑	☑	☑	☐	35 mins
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☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
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☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: No adherence

OBSERVER: BB / CB

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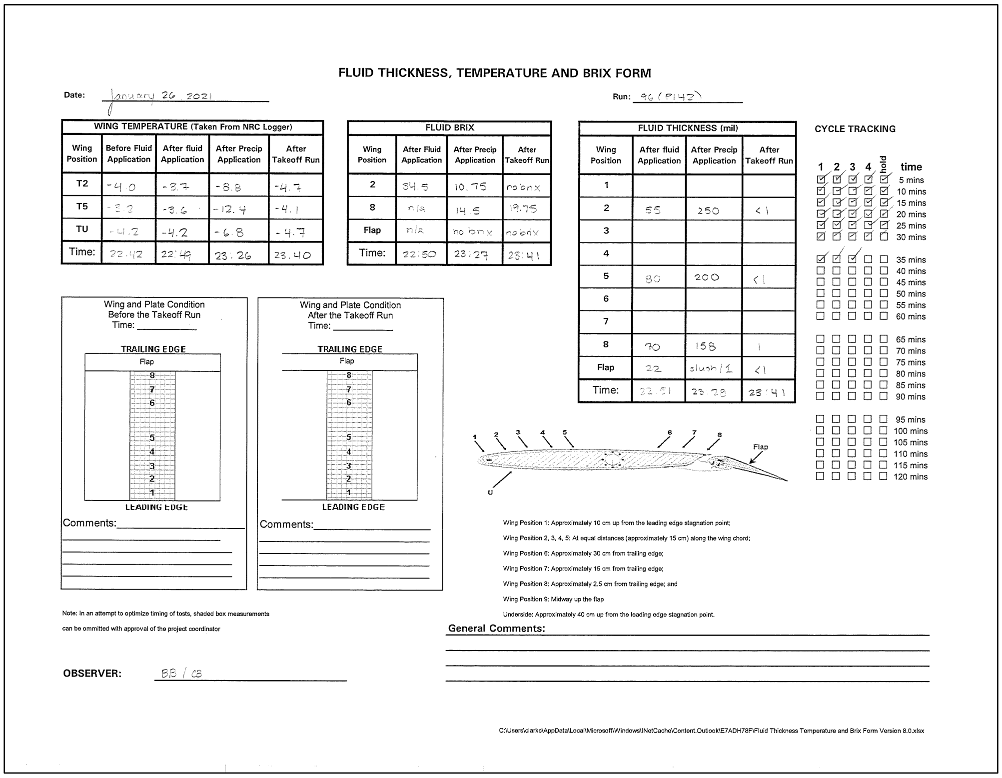
Figure C95: Run # 95



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26 2021

Run: 96 (P142)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.0	-3.7	-8.8	-4.7
T5	-3.2	-3.6	-12.4	-4.1
TU	-4.2	-4.2	-6.8	-4.7
Time:	22.42	22:49	23:26	23.40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	10.75	no brix
8	n/a	14.5	19.75
Flap	n/a	no brix	no brix
Time:	22:50	23:27	23:41

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	250	<1
3			
4			
5	80	200	<1
6			
7			
8	70	158	1
Flap	22	slush/1	<1
Time:	22.51	23:28	23:41

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
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☐	☐	☐	☐	☐	75 mins
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☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

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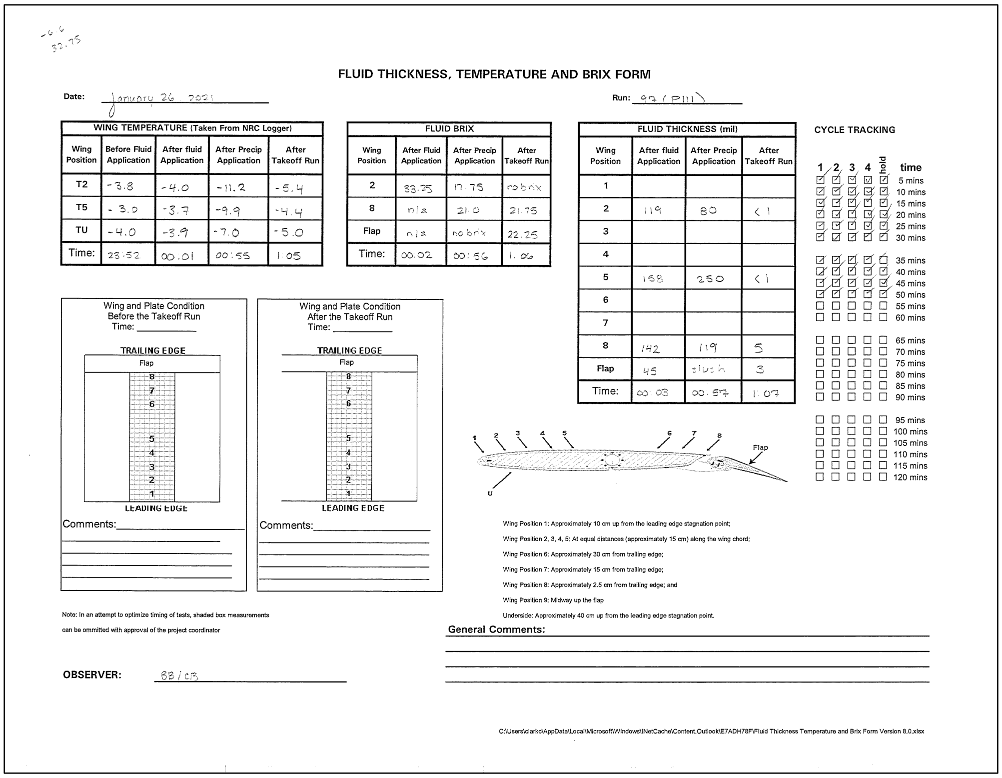
Figure C96: Run # 96



-6.6
32.75

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2021

Run: 97 (P111)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.8	-4.0	-11.2	-5.4
T5	-3.0	-3.7	-9.9	-4.4
TU	-4.0	-3.9	-7.0	-5.0
Time:	23:52	00:01	00:55	1:05

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	17.75	no brix
8	n/a	21.0	21.75
Flap	n/a	no brix	22.25
Time:	00:02	00:56	1:06

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	80	<1
3			
4			
5	158	250	<1
6			
7			
8	142	119	5
Flap	45	slush	3
Time:	00:03	00:57	1:07

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
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☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

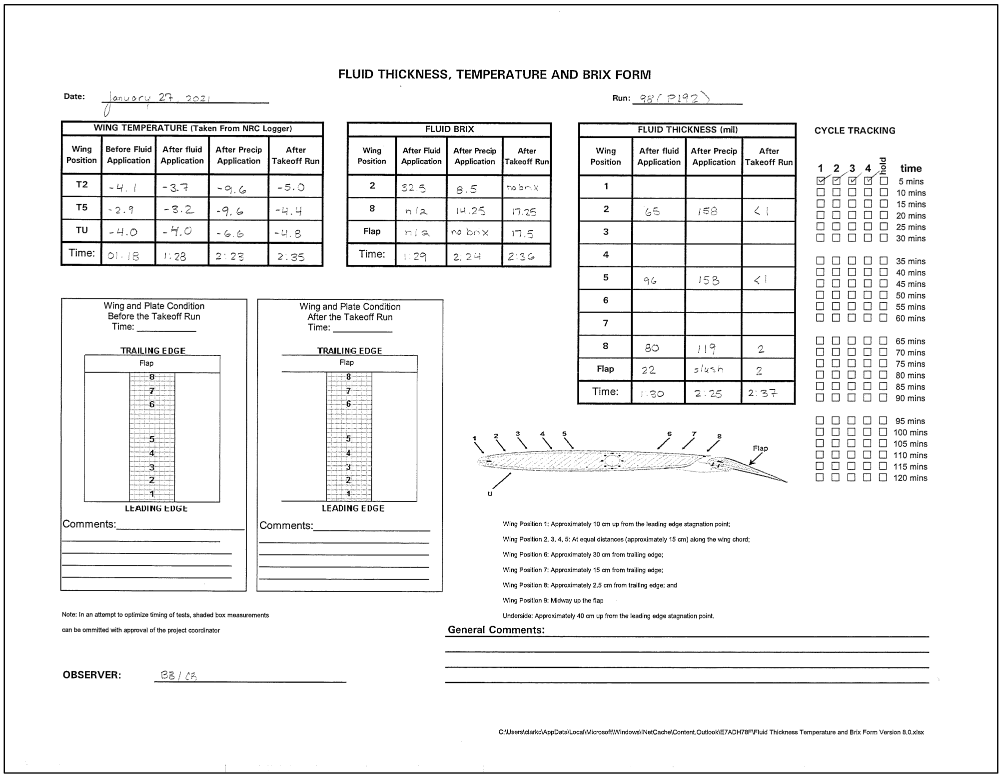
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

C:\Users\clarkc\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\E7ADH78F\Fluid Thickness Temperature and Brix Form Version 8.0.xlsx

Figure C97: Run # 97



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2021

Run: 98 (P192)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.1	-3.7	-9.6	-5.0
T5	-2.9	-3.2	-9.6	-4.4
TU	-4.0	-4.0	-6.6	-4.8
Time:	01:18	1:28	2:23	2:35

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	8.5	no brix
8	n/a	14.25	17.25
Flap	n/a	no brix	17.5
Time:	1:29	2:24	2:36

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	158	<1
3			
4			
5	96	158	<1
6			
7			
8	80	119	2
Flap	22	slush	2
Time:	1:30	2:25	2:37

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☐	5 mins
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☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

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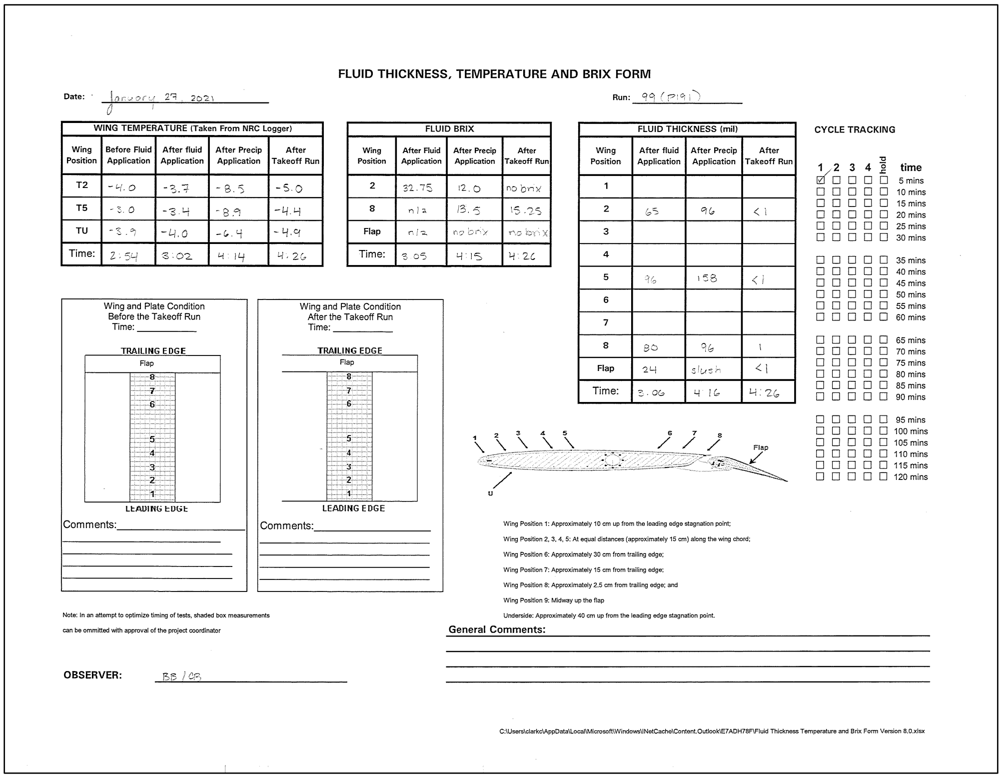
Figure C98: Run # 98



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2021

Run: 99 (P191)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.0	-3.7	-8.5	-5.0
T5	-3.0	-3.4	-8.9	-4.4
TU	-3.9	-4.0	-6.4	-4.9
Time:	2:54	3:02	4:14	4:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	12.0	no brix
8	n/a	13.5	15.25
Flap	n/a	no brix	no brix
Time:	3.05	4:15	4:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	96	<1
3			
4			
5	96	158	<1
6			
7			
8	80	96	1
Flap	24	slush	<1
Time:	3.06	4:16	4:26

CYCLE TRACKING

1	2	3	4	hold	time
☑	☐	☐	☐	☐	5 mins
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☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BB / CR

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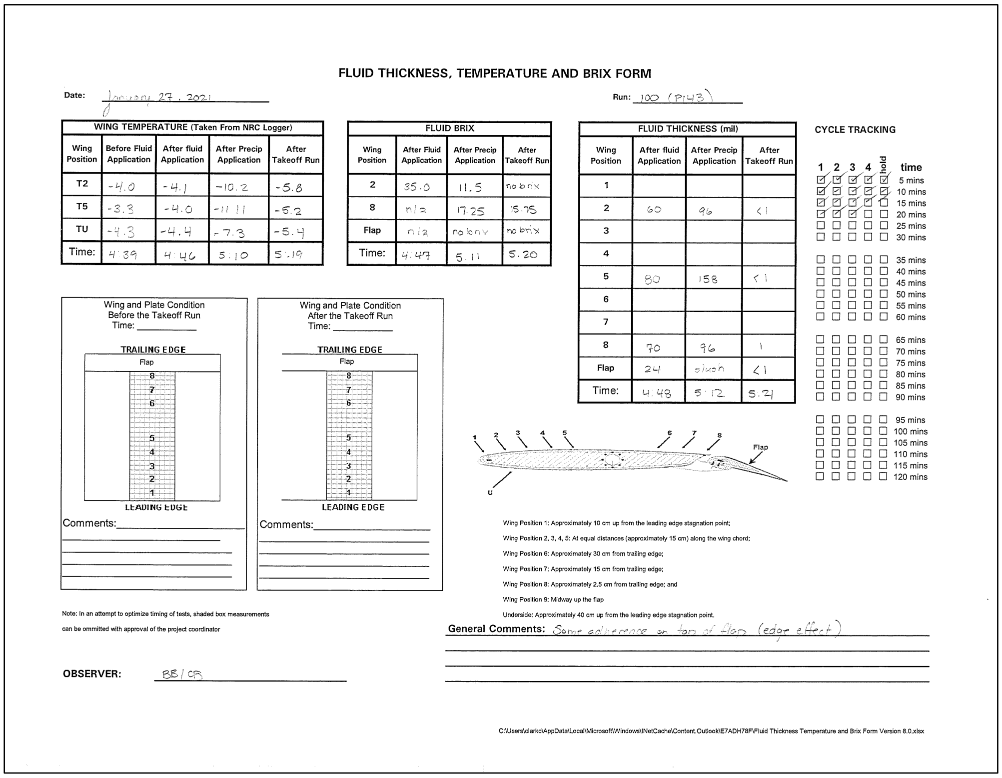
Figure C99: Run # 99



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2021

Run: 100 (P143)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.0	-4.1	-10.2	-5.8
T5	-3.3	-4.0	-11.11	-5.2
TU	-4.3	-4.4	-7.3	-5.4
Time:	4:39	4:46	5:10	5:19

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	11.5	no brix
8	n/a	17.25	15.75
Flap	n/a	no brix	no brix
Time:	4:47	5.11	5.20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	96	<1
3			
4			
5	80	158	<1
6			
7			
8	70	96	1
Flap	24	slush	<1
Time:	4:48	5:12	5:21

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
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☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Some adherence on top of flap (edge effect)

OBSERVER: BB / CR

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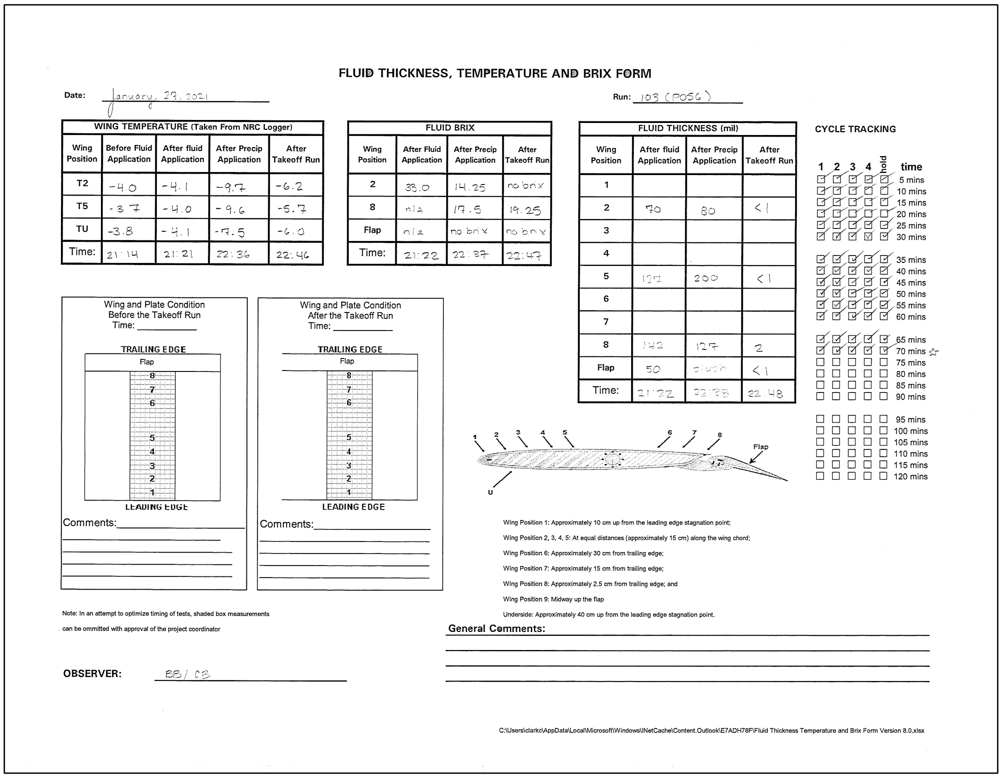
Figure C100: Run # 100

No Data Available

Figure C101: Run # 101

No Data Available

Figure C102: Run # 102



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2021

Run: 103 (P056)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.0	-4.1	-9.7	-6.2
T5	-3.7	-4.0	-9.6	-5.7
TU	-3.8	-4.1	-7.5	-6.0
Time:	21:14	21:21	22:36	22:46

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	14.25	no brix
8	n/a	17.5	19.25
Flap	n/a	no brix	no brix
Time:	21:22	22:37	22:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	80	<1
3			
4			
5	127	200	<1
6			
7			
8	142	127	2
Flap	50	slush	<1
Time:	21:22	22:38	22:48

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
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☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB/ CB

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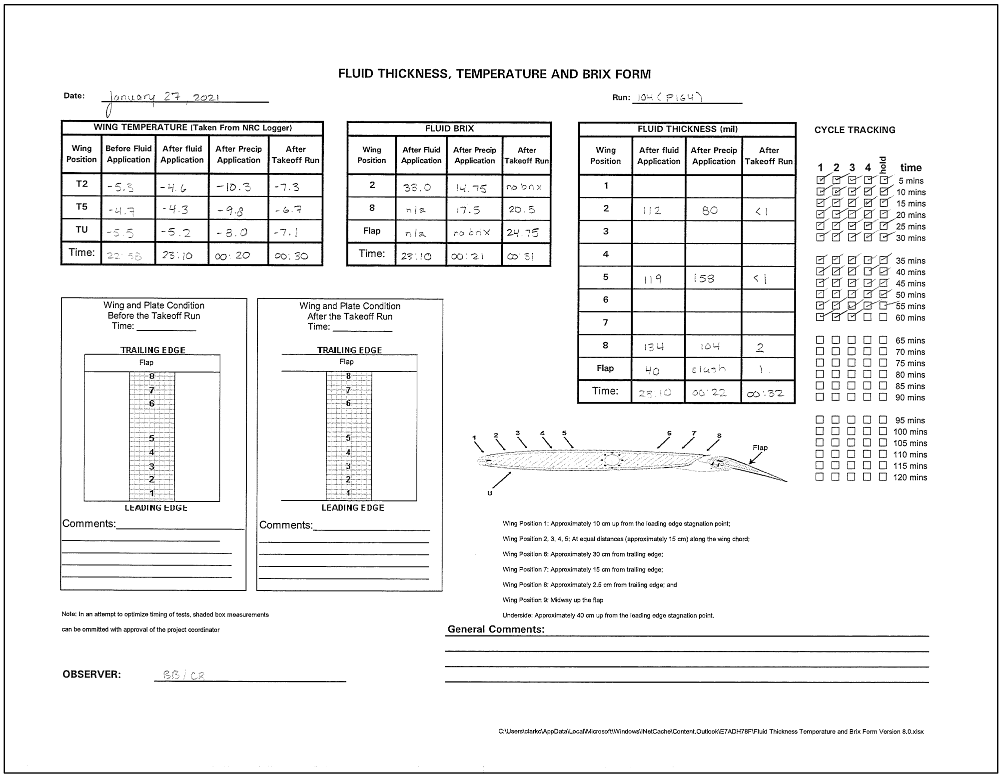
Figure C103: Run # 103



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2021

Run: 104 (P164)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.3	-4.6	-10.3	-7.3
T5	-4.7	-4.3	-9.8	-6.7
TU	-5.5	-5.2	-8.0	-7.1
Time:	22:58	23:10	00:20	00:30

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	14.75	no brix
8	n/a	17.5	20.5
Flap	n/a	no brix	24.75
Time:	23:10	00:21	00:31

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	80	<1
3			
4			
5	119	158	<1
6			
7			
8	134	104	2
Flap	40	slush	1.
Time:	23:10	00:22	00:32

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☑	☑	☑	50 mins
☑	☑	☑	☑	☑	55 mins
☑	☑	☑	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CR

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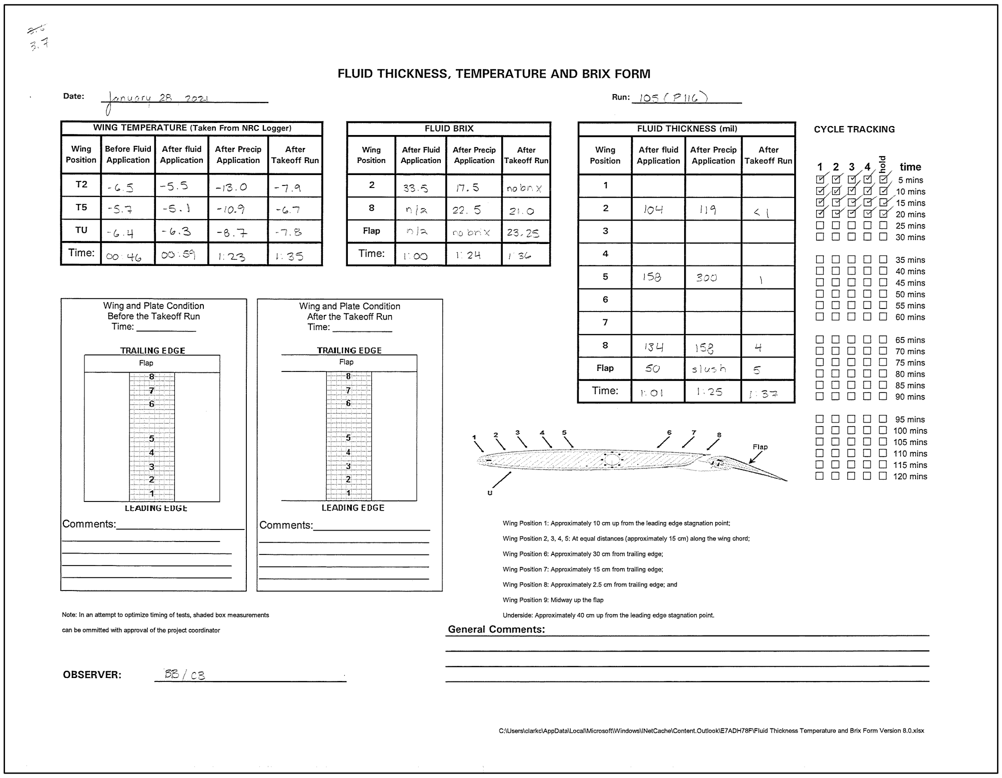
Figure C104: Run # 104



~~3.6~~
3.7

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28 2021

Run: 105 (P116)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.5	-5.5	-13.0	-7.9
T5	-5.7	-5.1	-10.9	-6.7
TU	-6.4	-6.3	-8.7	-7.8
Time:	00:46	00:59	1:23	1:35

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	17.5	no brix
8	n/a	22.5	21.0
Flap	n/a	no brix	23.25
Time:	1:00	1:24	1:36

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	119	< 1
3			
4			
5	158	300	1
6			
7			
8	134	158	4
Flap	50	slush	5
Time:	1:01	1:25	1:37

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements
can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

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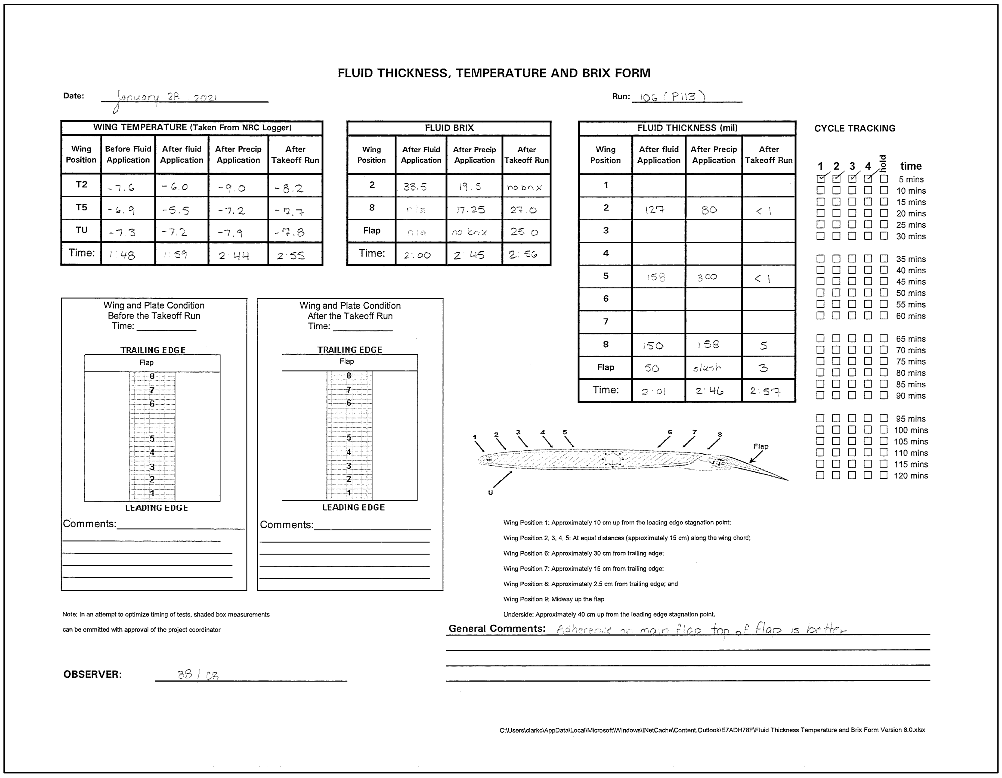
Figure C105: Run # 105



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28 2021

Run: 106 (P113)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.6	-6.0	-9.0	-8.2
T5	-6.9	-5.5	-7.2	-7.7
TU	-7.3	-7.2	-7.9	-7.8
Time:	1:48	1:59	2:44	2:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	19.5	no brix
8	n/a	17.25	27.0
Flap	n/a	no brix	25.0
Time:	2:00	2:45	2:56

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	80	< 1
3			
4			
5	158	300	< 1
6			
7			
8	150	158	5
Flap	50	slush	3
Time:	2:01	2:46	2:57

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
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☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements
can be ommitted with approval of the project coordinator

General Comments: Adherence on main flap top of flap is better

OBSERVER: BB / CB

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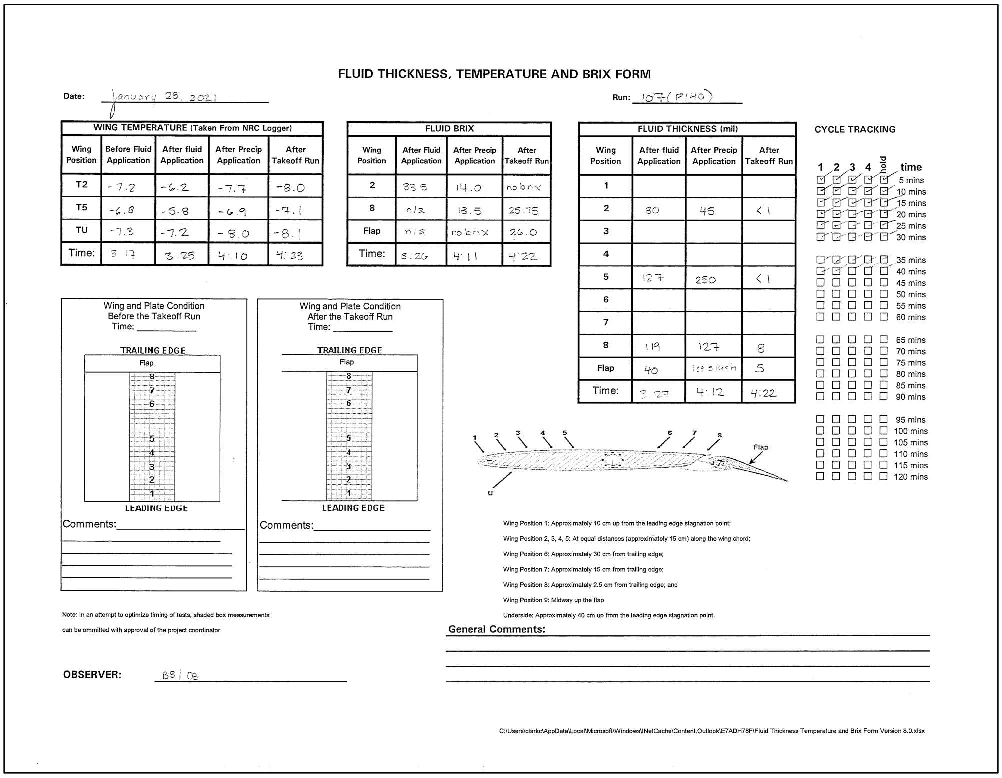
Figure C106: Run # 106



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28, 2021

Run: 107 (P140)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.2	-6.2	-7.7	-8.0
T5	-6.8	-5.8	-6.9	-7.1
TU	-7.3	-7.2	-8.0	-8.1
Time:	3:17	3:25	4:10	4:23

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	14.0	no brix
8	n/a	13.5	25.75
Flap	n/a	no brix	26.0
Time:	3:26	4:11	4:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	45	<1
3			
4			
5	127	250	<1
6			
7			
8	119	127	8
Flap	40	ice slush	5
Time:	3:27	4:12	4:22

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☐	☑	☑	☑	☑	35 mins
☑	☑	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
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☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements
can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

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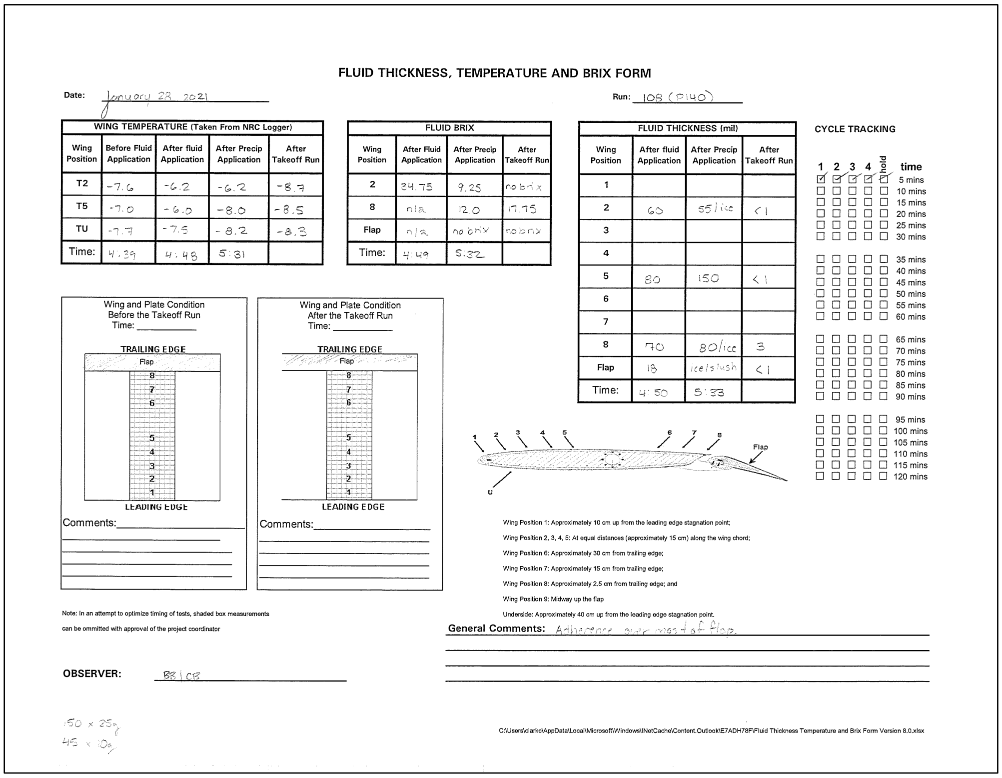
Figure C107: Run # 107



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28 2021

Run: 108 (P140)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.6	-6.2	-6.2	-8.7
T5	-7.0	-6.0	-8.0	-8.5
TU	-7.7	-7.5	-8.2	-8.3
Time:	4:39	4:48	5:31	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	9.25	no brix
8	n/a	12.0	17.75
Flap	n/a	no brix	no brix
Time:	4:49	5:32	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	55/ice	<1
3			
4			
5	80	150	<1
6			
7			
8	70	80/ice	3
Flap	18	ice/slush	<1
Time:	4:50	5:33	

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements
can be ommitted with approval of the project coordinator

General Comments: Adherence over most of flap.

OBSERVER: BB / CB

150 × 25g/
45 × 10g/

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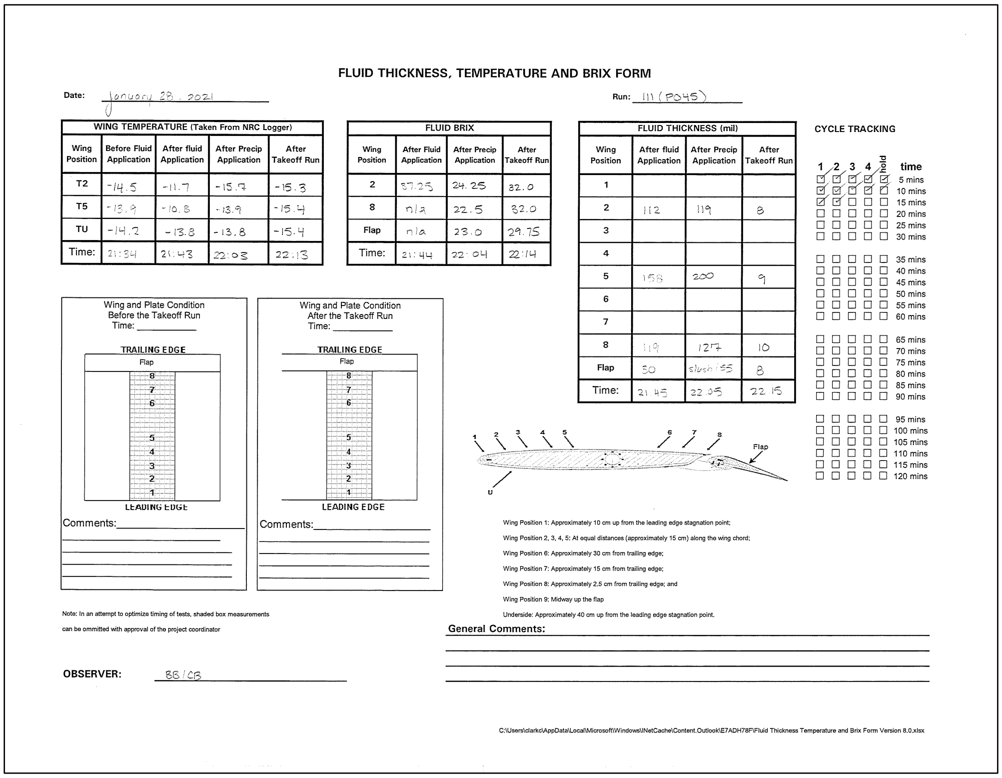
Figure C108: Run # 108

No Data Available

Figure C109: Run # 109

No Data Available

Figure C110: Run # 110



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28, 2021

Run: 111 (P045)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.5	-11.7	-15.7	-15.3
T5	-13.9	-10.8	-13.9	-15.4
TU	-14.2	-13.8	-13.8	-15.4
Time:	21:34	21:43	22:03	22:13

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	24.25	32.0
8	n/a	22.5	32.0
Flap	n/a	23.0	29.75
Time:	21:44	22:04	22:14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	119	8
3			
4			
5	158	200	9
6			
7			
8	119	127	10
Flap	30	slush 155	8
Time:	21:45	22:05	22:15

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☐	10 mins
☑	☑	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
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☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

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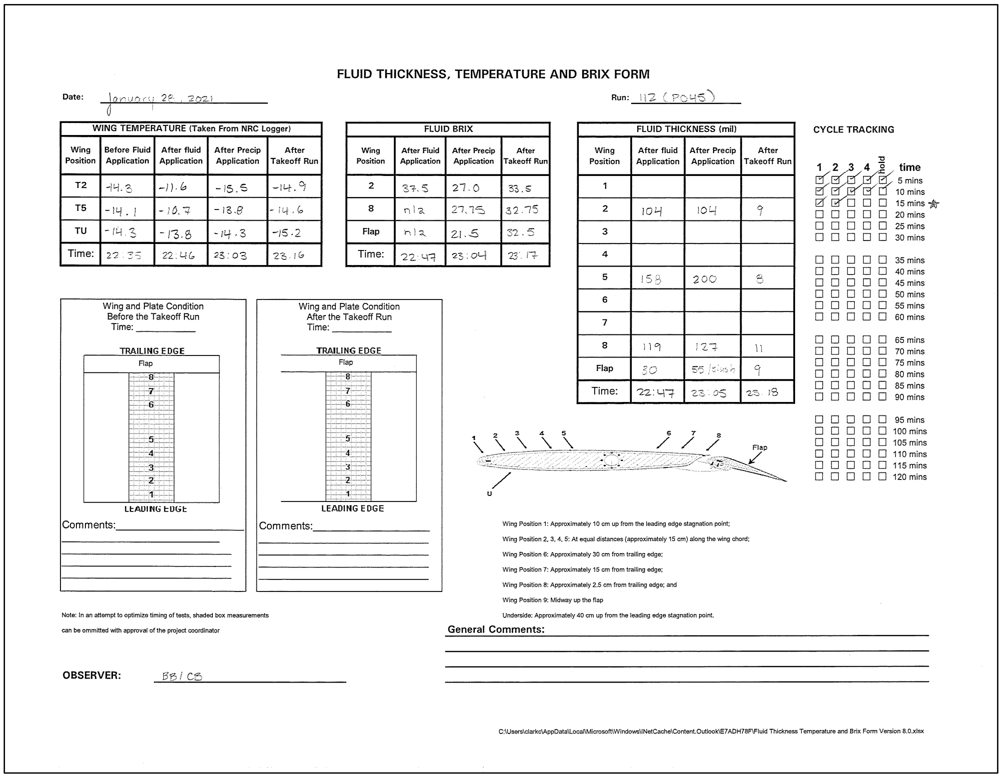
Figure C111: Run # 111



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28, 2021

Run: 112 (P045)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.3	-11.6	-15.5	-14.9
T5	-14.1	-10.7	-13.8	-14.6
TU	-14.3	-13.8	-14.3	-15.2
Time:	22:35	22:46	23:03	23:16

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	27.0	33.5
8	n/a	27.75	32.75
Flap	n/a	21.5	32.5
Time:	22:47	23:04	23:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	104	9
3			
4			
5	158	200	8
6			
7			
8	119	127	11
Flap	30	55 / slush	9
Time:	22:47	23:05	23:18

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☐	10 mins
☑	☑	☐	☐	☐	15 mins ☆
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments:

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

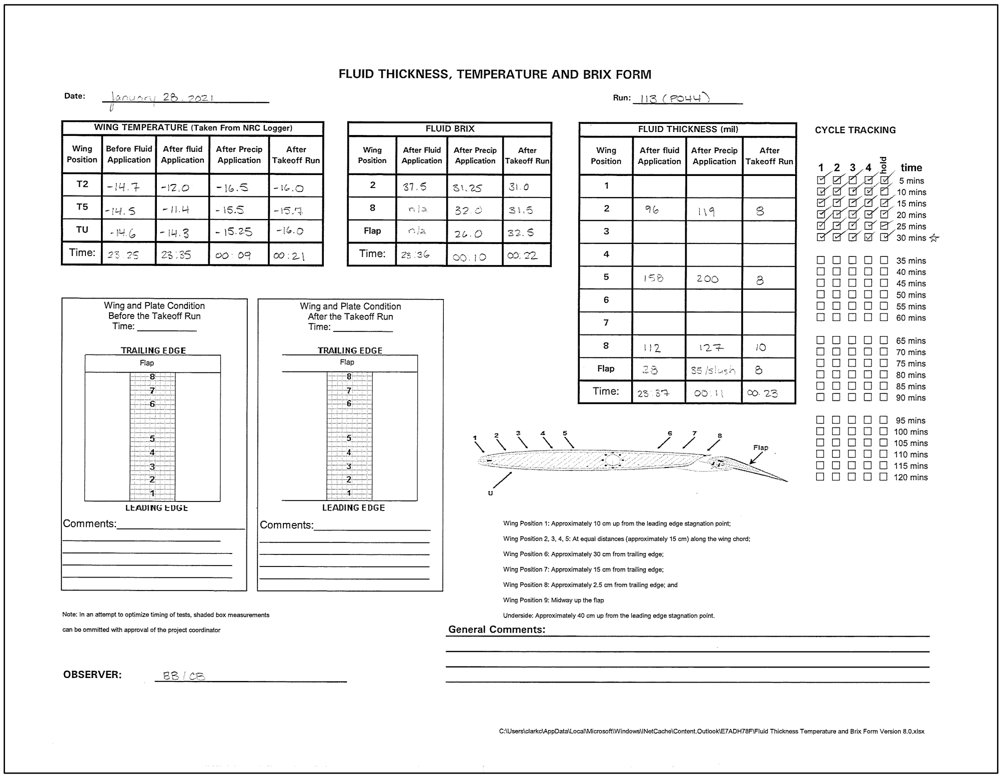
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

C:\Users\clarkc\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\E7ADH78F\Fluid Thickness Temperature and Brix Form Version 8.0.xlsx

Figure C112: Run # 112



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28, 2021

Run: 113 (P044)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.7	-12.0	-16.5	-16.0
T5	-14.5	-11.4	-15.5	-15.7
TU	-14.6	-14.3	-15.25	-16.0
Time:	23:25	23:35	00:09	00:21

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	31.25	31.0
8	n/a	32.0	31.5
Flap	n/a	26.0	32.5
Time:	23:36	00:10	00:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	119	8
3			
4			
5	158	200	8
6			
7			
8	112	127	10
Flap	28	35/slush	8
Time:	23:37	00:11	00:23

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins ☆
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BB / CB

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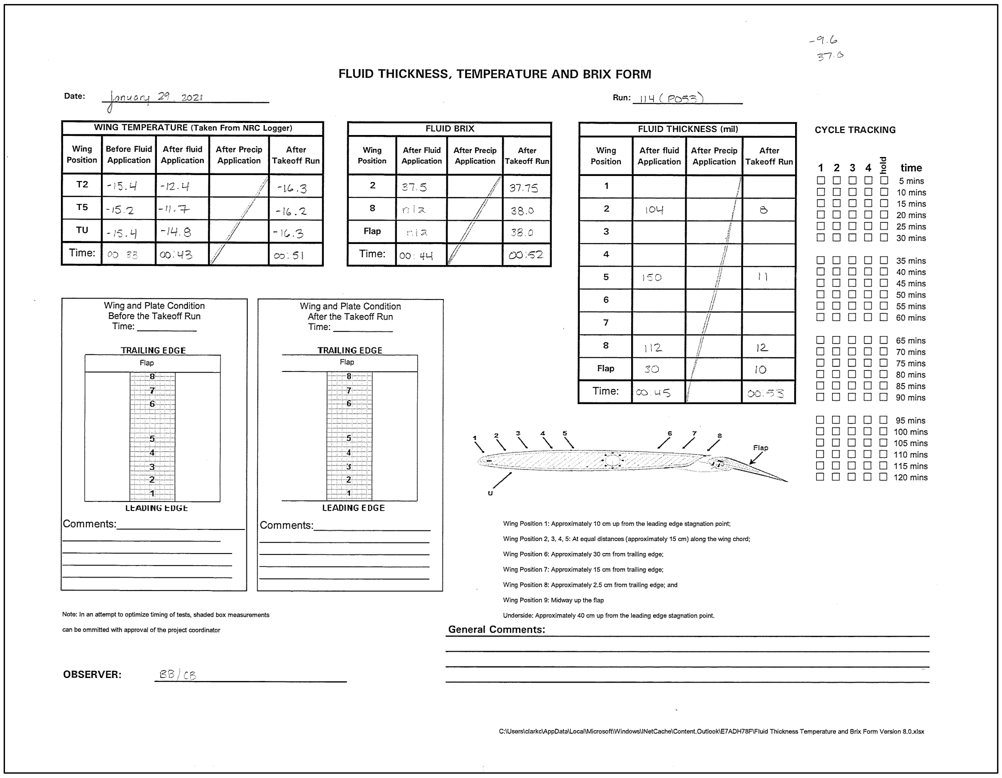
Figure C113: Run # 113



-9.6
37.0

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 29, 2021

Run: 114 (P053)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.4	-12.4		-16.3
T5	-15.2	-11.7		-16.2
TU	-15.4	-14.8		-16.3
Time:	00:33	00:43		00:51

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5		37.75
8	n/a		38.0
Flap	n/a		38.0
Time:	00:44		00:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104		8
3			
4			
5	150		11
6			
7			
8	112		12
Flap	30		10
Time:	00:45		00:53

CYCLE TRACKING

1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ____________

Comments: ____________

Wing and Plate Condition
After the Takeoff Run
Time: ____________

Comments: ____________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

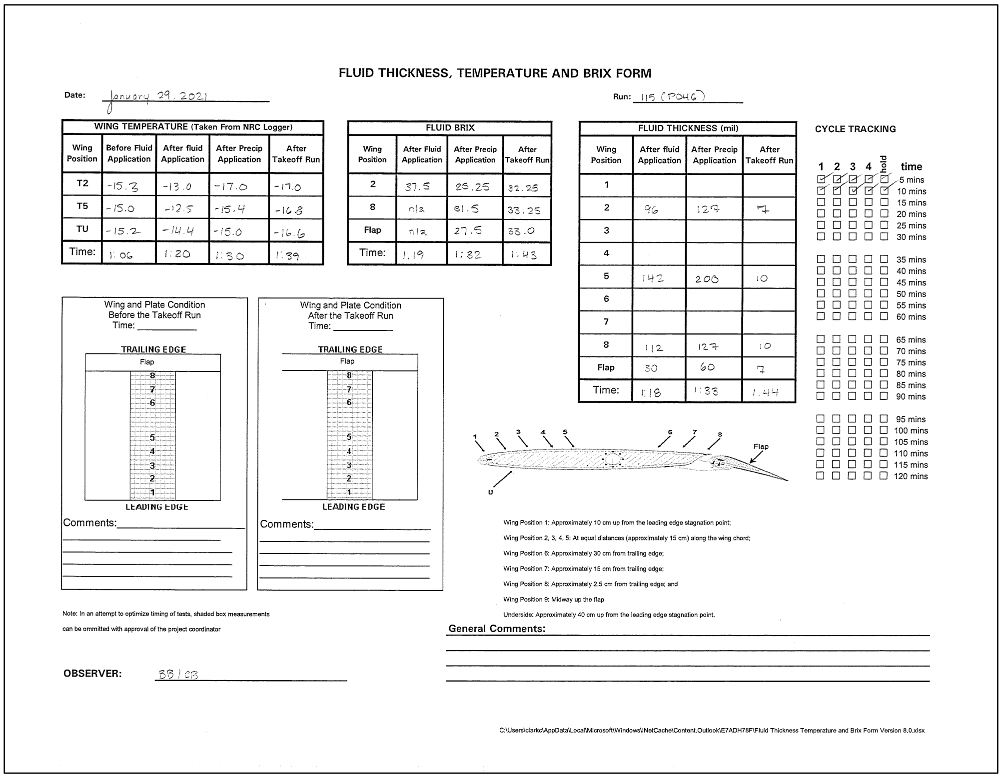
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____________

OBSERVER: BB / CB

C:\Users\clarkc\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\E7ADH78F\Fluid Thickness Temperature and Brix Form Version 8.0.xlsx

Figure C114: Run # 114



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 29, 2021

Run: 115 (P046)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.3	-13.0	-17.0	-17.0
T5	-15.0	-12.5	-15.4	-16.8
TU	-15.2	-14.4	-15.0	-16.6
Time:	1:06	1:20	1:30	1:39

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	25.25	32.25
8	n/a	81.5	33.25
Flap	n/a	27.5	33.0
Time:	1:19	1:32	1:43

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	7
3			
4			
5	142	200	10
6			
7			
8	112	127	10
Flap	30	60	7
Time:	1:18	1:33	1:44

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

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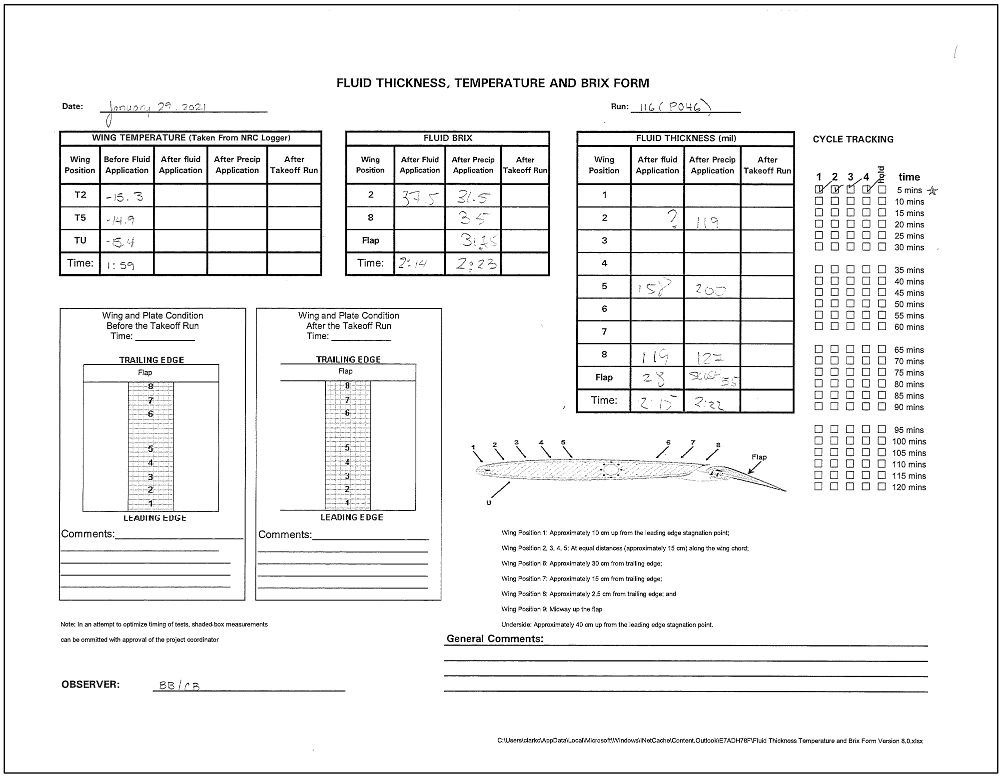
Figure C115: Run # 115



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 29, 2021

Run: 116 (P046)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.3			
T5	-14.9			
TU	-15.4			
Time:	1:59			

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	31.5	
8		35	
Flap		31.25	
Time:	2:14	2:23	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	?	119	
3			
4			
5	158	200	
6			
7			
8	119	127	
Flap	28	SLUSH 55	
Time:	2:15	2:22	

CYCLE TRACKING

1	2	3	4	hold	time
☑	☑	☑	☑	☐	5 mins ☆
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

Comments: ___________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

Comments: ___________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________

OBSERVER: BB / CB

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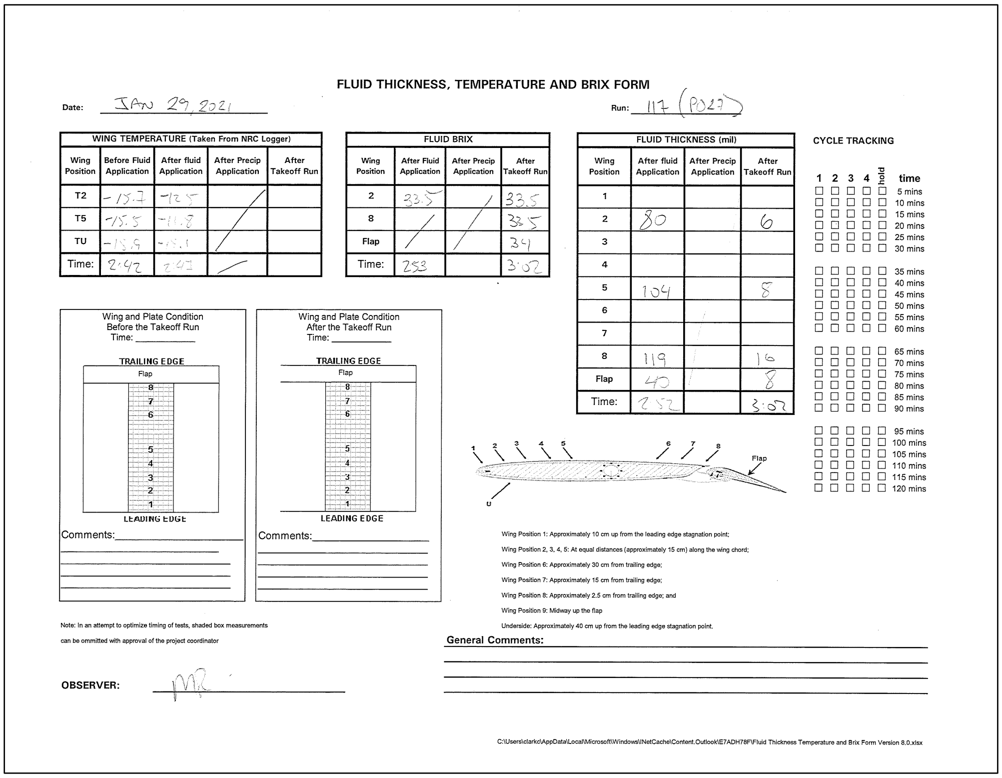
Figure C116: Run # 116



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 29, 2021

Run: 117 (P027)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.7	-12.5	/	
T5	-15.5	-11.8	/	
TU	-15.9	-15.1	/	
Time:	2:42	2:43	—	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	/	33.5
8	/	/	33.5
Flap	/	/	34
Time:	253		3:02

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80		6
3			
4			
5	104		8
6			
7			
8	119		16
Flap	40		8
Time:	2:52		3:02

CYCLE TRACKING

1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	85 mins
☐	☐	☐	☐	☐	90 mins
☐	☐	☐	☐	☐	95 mins
☐	☐	☐	☐	☐	100 mins
☐	☐	☐	☐	☐	105 mins
☐	☐	☐	☐	☐	110 mins
☐	☐	☐	☐	☐	115 mins
☐	☐	☐	☐	☐	120 mins

Wing and Plate Condition
Before the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________________

Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

Comments:___________________

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;

Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;

Wing Position 6: Approximately 30 cm from trailing edge;

Wing Position 7: Approximately 15 cm from trailing edge;

Wing Position 8: Approximately 2.5 cm from trailing edge; and

Wing Position 9: Midway up the flap

Underside: Approximately 40 cm up from the leading edge stagnation point.

Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ___________________

OBSERVER: ___________________

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Figure C117: Run # 117

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APPENDIX D

2020-21 LOG OF TESTS CONDUCTED WITH THIN HIGH PERFORMANCE WING SECTION – RJ WING

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
1	11-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	-0.27%	-3.07	-6.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	11-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.75%	-3.07	-6.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	11-Jan-21	P025	Type IV Validation and New Fluids	Fluid Only	ClearWing EG	8	100	20	3.71%	-4.81	-6.6	-5.1	-4.6	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	11-Jan-21	P051	Type IV Validation and New Fluids	Fluid Only	Polar Guard Xtend	8	100	20	6.38%	-3.26	-6.3	-3.8	-3.6	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	11-Jan-21	P030	Type IV Validation and New Fluids	IP-	Polar Guard Xtend	8	100	20	3.98%	-2.3	-6	-3.3	-7.7	29	-	-	-	50	2.65	2.65	4	1.05	2.25	2.1	1	1.05	1.25
6	11-Jan-21	P031	Type IV Validation and New Fluids	IP- / SN-	Polar Guard Xtend	8	100	20	7.14%	-3.66	-5.8	-3.7	-8.6	29	12	-	-	40	3.5	2.95	4	1.05	1.95	3.15	1	1.05	1.85
7	11-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	-0.41%	4.08	0.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	11-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.96%	4.08	0.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
9	11-Jan-21	P035	Type IV Validation and New Fluids	IP Mod	Polar Guard Xtend	8	100	20	3.71%	1.11	0.8	3.4	-5.5	75	-	-	-	15	2.25	2.05	2.75	1	1.5	1.25	1	1	1
10	11-Jan-21	P004	Type IV Validation and New Fluids	IP-	ClearWing EG	8	100	20	1.44%	-0.08	0.4	0.7	-5.3	25	-	-	-	50	2	1.55	3.75	1	1	1.1	1	1	1
11	12-Jan-21	P033	Type IV Validation and New Fluids	IP- / ZR-	Polar Guard Xtend	8	100	20	3.50%	-0.13	0.23	0.4	-3.0	25	-	25	-	25	2.1	1.4	1.7	1	1	1	1	1	1
12	12-Jan-21	P037	Type IV Validation and New Fluids	IP Mod / R	Polar Guard Xtend	8	100	20	2.81%	-0.35	0.1	-0.4	-4.0	92	-	-	75	10	2.25	1.75	3.4	1	1.1	1.35	1	1.05	1.05

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
13	12-Jan-21	P198	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	13.04%	-0.05	0	-0.5	-1.9	92	-	-	75	20	3.5	3.4	5	2.25	1	4.5	1.1	1	4.5
14	12-Jan-21	P198	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	7.14%	-0.61	-0.2	-0.5	-3.5	92	-	-	75	15	3	2.9	5	1	1	4	1	1	4
15	12-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.48%	1.45	0.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	12-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.62%	1.45	0.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17	12-Jan-21	P063	EG Type IV Expansion	IP Mod / R	Max Flight AVIA	8	100	20	3.16%	0.13	0.4	1.2	-4.2	92	-	-	75	15	2.65	2	4	1	1	3.75	1	1	3.15
18	12-Jan-21	P117	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	5.42%	-0.26	0.2	-0.3	-5.1	92	-	-	75	15	2	1.35	5	1	1	4	1	1	3.9
19	12-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	11.74%	-0.67	0	-0.3	-4.3	92	-	-	75	15	2.65	2.9	5	1	1	4.5	1	1	4.5
20	13-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	0	5.90%	-0.61	-0.2	-0.2	-4.3	92	-	-	75	15	2.5	2.4	5	1	1	1	1	1	1
21	13-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	0	2.13%	-0.66	-0.4	0.2	-4.5	92	-	-	75	12	1.75	2	4.25	1	1	1.05	1	1	1
22	13-Jan-21	P090	EG Type IV Expansion	IP Mod / R	Safewing EG IV NORTH	8	100	20	6.66%	-0.57	-0.5	0.7	-3.6	92	-	-	75	15	3.15	3	5	1	1.05	4	1	1	4
23	13-Jan-21	P195	EG Type IV Expansion	IP- / R-	ClearWing EG	8	100	20	3.09%	-0.31	-0.7	0.0	-4.4	32	-	-	25	25	1.75	1.3	5	1	1	3.75	1	1	3.5
24	13-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.82%	3.2	0.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
25	13-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	2.06%	3.2	0.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
26	13-Jan-21	P144	EG Type IV Expansion	IP Mod / R	ChemR EG IV	8	100	20	2.33%	1.57	0.5	1.8	-2.4	92	-	-	75	15	2.9	2.5	4	1	1	3	1	1	1.5
27	13-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.13	0.7	1.4	-3.6	92	-	-	75	15	2.25	2	4	1	1	2	1	1	1.25
28	14-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.96%	4.9	0.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
29	14-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	1.92%	4.9	0.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
30	14-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.7	0.7	2.5	-3.6	75	-	-	75	20	2.65	2.35	4	1	1	1.55	1	1	1
31	15-Jan-21	P171	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.95	0.7	0.9	-4.3	75	-	-	75	15	1.35	2	3.5	1	1	1.3	1	1	1
32	15-Jan-21	P198	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	1.03%	2.13	0.7	1.2	-1.8	75	-	-	75	20	3	2.9	4	1	1	1.15	1	1	1.05
33	15-Jan-21	P117	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	2.33%	1.21	0.6	1.3	-4.5	75	-	-	75	20	2	1.65	5	1	1	2.25	1	1	1.05
34	15-Jan-21	P117	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	0	1.58%	1.01	0.5	0.5	-4.5	75	-	-	75	20	2	1.65	5	1	1	1.15	1	1	1
35	15-Jan-21	P117	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	2.33%	1.08	0.4	0.4	-5.4	75	-	-	75	15	1.6	1.3	4.25	1	1	1.3	1	1	1.05
36	17-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.96%	-4.48	-4.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
37	17-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	1.44%	-4.48	-4.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
38	17-Jan-21	P009	Type IV Validation and New Fluids	IP Mod	ClearWing EG	8	100	20	1.99%	-5.07	-4.5	-3.6	-10.1	75	-	-	-	25	2.25	2.15	3.75	1	1	1	1	1	1
39	17-Jan-21	P005	Type IV Validation and New Fluids	IP- / SN-	ClearWing EG	8	100	20	2.81%	-4.98	-5	-5.4	-9.8	25	10	-	-	40	3	2.25	3.75	1	1.5	2.25	1	1	1
40	18-Jan-21	P007	Type IV Validation and New Fluids	IP- / ZR-	ClearWing EG	8	100	20	7.28%	-6.14	-5.8	-5.9	-7.5	25	-	25	-	25	2.5	2.05	5	1	1	5	1	1	5
41	18-Jan-21	P007	Type IV Validation and New Fluids	IP- / ZR-	ClearWing EG	8	100	0	1.65%	-6.49	-6.7	-5.7	-7.9	25	-	25	-	25	2.5	2	3.25	1	1	1.55	1	1	1.05
42	18-Jan-21	P196	EG Type IV Expansion	IP Mod	ClearWing EG	8	100	20	2.20%	-7.51	-7.3	-6.1	-11.5	75	-	-	-	35	3.5	2.9	4	1	8.1	1.75	1	1	1.05
43	18-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.69%	-7.33	-8.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
44	18-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	1.78%	-7.33	-8.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
45	18-Jan-21	P041	Type IV Validation and New Fluids	IP- / ZR-	Polar Guard Xtend	8	100	20	7.07%	-8.32	-8.9	-7.0	-6.9	25	-	25	-	10	2	1.9	2.5	1	1.75	2	1	1.05	1.25
46	18-Jan-21	P038	Type IV Validation and New Fluids	IP-	Polar Guard Xtend	8	100	20	7.55%	-8.77	-9	-7.5	-10.3	25	-	-	-	30	2.15	2	3	1	2	2.25	1	1	1.1
47	18-Jan-21	P003	Type IV Validation and New Fluids	IP- / SN-	Max Flight SNEG	8	100	20	8.10%	-8.68	-9	-7.1	-9.9	25	10	-	-	15	2.15	2.05	3.25	1.1	1.5	1.85	1	1.05	1.05
48	19-Jan-21	P064	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	2.54%	-9.51	-9.53	-7.9	-12.2	25	-	-	-	50	2	2	3.5	1	1	1.3	1	1	1

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
49	19-Jan-21	P199	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	2.68%	-7.73	-9.8	-8.6	-11.6	25	-	-	-	50	2.1	2	3.65	1	1.05	1.35	1	1	1
50	19-Jan-21	P176	EG Type IV Expansion	IP Mod	EG106	8	100	20	2.20%	-7.8	-10.2	-7.7	-13.6	75	-	-	-	25	2.5	2.25	3.75	1	1	1.2	1	1	1
51	19-Jan-21	P068	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	3.29%	-8.71	-10.5	-8.9	-13.9	75	-	-	-	25	2.5	2.25	3.75	1	1.15	1.25	1	1	1
52	19-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	1.03%	-2.41	-8.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
53	19-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	2.20%	-2.41	-8.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
54	19-Jan-21	P042	Type IV Validation and New Fluids	IP Mod	Polar Guard Xtend	8	100	20	7.48%	-5.45	-8	-6.1	-8.6	75	-	-	-	10	2	1.75	2.25	1	1.3	1.65	1	1	1
55	19-Jan-21	P061	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	2.06%	-6.21	-8.3	-5.6	-12.3	75	-	-	-	35	2.9	2.5	4	1	1.1	1.15	1	1	1
56	19-Jan-21	P169	EG Type IV Expansion	IP Mod	EG106	8	100	20	1.92%	-6.87	-8.5	-6.8	-12.1	75	-	-	-	35	3	2.5	4	1	1	1.05	1	1	1
57	20-Jan-21	P137	EG Type IV Expansion	IP-	ChemR EG IV	8	100	20	2.20%	-6.61	-8.5	-6.5	-9.7	25	-	-	-	70	3	2.5	4	1	1.05	1.05	1	1	1
58	20-Jan-21	P110	EG Type IV Expansion	IP-	Defrost EG 4	8	100	20	3.29%	-6.01	-8.2	-6.7	-10.4	25	-	-	-	70	2.5	2.25	3.7	1	1	1.1	1	1	1
59	20-Jan-21	P059	EG Type IV Expansion	IP- / ZR-	Max Flight AVIA	8	100	20	5.77%	-8.14	-8.2	-7.2	-8.3	25	-	25	-	40	3	2.5	5	1.15	1.15	5	1	1	2
60	20-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.62%	-8.12	-12.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
61	20-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	1.65%	-8.12	-12.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
62	20-Jan-21	P065	EG Type IV Expansion	IP- / SN-	Max Flight AVIA	8	100	20	3.36%	-9.37	-12.1	-10.2	-13.4	25	10	-	-	30	2.35	2.25	3.75	1	1.15	1.6	1	1	1
63	20-Jan-21	P200	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	4.87%	-9.27	-12.3	-10.1	-13.3	25	10	-	-	30	2.95	2.55	3.85	1	1.65	2.25	1	1.1	1.3
64	20-Jan-21	P173	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	3.64%	-9.59	-13	-10.1	-13.3	25	10	-	-	30	2.6	2.25	3.9	1	1.2	1.75	1	1.05	1.1
65	21-Jan-21	P094	EG Type IV Expansion	IP- / ZR-	Safewing EG IV NORTH	8	100	20	5.15%	-9.9	-13.1	-11.1	-10.3	25	-	25	-	30	3	2.275	5	1	1	5	1	1	5
66	21-Jan-21	P067	EG Type IV Expansion	IP- / ZR-	Max Flight AVIA	8	100	20	7.00%	-10.59	-13	-9.9	-10.1	25	-	25	-	30	2.75	2.4	5	1	1.1	5	1	1	5
67	21-Jan-21	P148	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	7.48%	-10.58	-12.9	-9.5	-9.7	25	-	25	-	30	3	2.5	5	1.1	1.75	5	1	1.5	5
68	21-Jan-21	P039	Type IV Validation and New Fluids	IP- / SN-	Polar Guard Xtend	8	100	20	9.40%	-9.68	-13	-10.5	-11.7	25	10	-	-	15	2.25	2	3.25	1.15	1.9	2.1	1.1	1.15	1.5
69	21-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.21%	-2.33	-8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
70	21-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.62%	-2.33	-8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
71	21-Jan-21	P165	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	3.16%	-3.68	-7.1	-5.3	-9.9	25	10	-	-	50	2.75	2	4	1	1.05	2.25	1	1	1.1
72	21-Jan-21	P057	EG Type IV Expansion	IP- / SN-	Max Flight AVIA	8	100	20	2.33%	-3.24	-5.7	-3.8	-9.4	25	10	-	-	50	3	2.5	4	1	1.15	1.5	1	1	1

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
73	22-Jan-21	P194	EG Type IV Expansion	IP- / ZR-	ClearWing EG	8	100	20	6.52%	-2.31	-4.5	-2.8	-5.9	25	-	25	-	40	3	2.5	5	1	1	5	1	1	5
74	22-Jan-21	P140	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	9.88%	-1.88	-2.1	-2.2	-4.7	25	-	25	-	40	3	2.6	5	1	1	5	1	1	5
75	22-Jan-21	P140	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	12.83%	-2.41	-2	-1.6	-4.7	25	-	25	-	35	2.75	2.15	5	1	1	5	1	1	5
76	22-Jan-21	P140	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	0	2.26%	-3.42	-3.08	-2.5	-5.2	25	-	25	-	40	3	2.65	4.5	1	1.05	2.25	1	1	1.25
77	24-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	-0.96%	-9.63	-10.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
78	24-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.21%	-9.63	-10.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
79	25-Jan-21	P066	EG Type IV Expansion	IP- / ZD	Max Flight AVIA	8	100	20	5.56%	-10.12	-12.1	-10.4	-11.3	25	-	13	-	30	3	2.85	5	1	1	5	1	1	5
80	25-Jan-21	P201	EG Type IV Expansion	IP- / ZD	ClearWing EG	8	100	20	6.73%	-8.96	-12.5	-10.7	-11.2	25	-	13	-	30	2.5	2.5	5	1	1.15	5	1	1.05	5
81	25-Jan-21	P177	EG Type IV Expansion	IP Mod/ZD	EG106	8	100	20	2.61%	-10.22	-12.4	-9.5	-12.9	75	-	13	-	10	2.6	2.5	3.45	1	1.1	1.3	1	1.05	1.05
82	25-Jan-21	P096	EG Type IV Expansion	IP Mod/ZD	Safewing EG IV NORTH	8	100	20	3.98%	-9.35	-11.9	-10.5	-13.4	75	-	13	-	15	3	3	4	1	1.05	2.5	1	1	1.35
83	25-Jan-21	P069	EG Type IV Expansion	IP Mod/ZD	Max Flight AVIA	8	100	20	3.36%	-9.48	-11.8	-10.1	-13.3	75	-	13	-	15	2.75	2.65	4	1	1.1	1.5	1	1	1.1
84	25-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	2.06%	-3.65	-7.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
85	25-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	2.95%	-3.65	-7.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
86	25-Jan-21	P062	EG Type IV Expansion	IP Mod/ZD	Max Flight AVIA	8	100	20	3.57%	-3.91	-7.2	-5.7	-10.8	75	-	13	-	20	2.65	2.5	4	1	1	2.5	1	1	1
87	25-Jan-21	P170	EG Type IV Expansion	IP Mod/ZD	EG106	8	100	20	7.41%	-4.3	-6.8	-5.5	-10.3	75	-	13	-	25	2.5	2.5	5	1	1.05	5	1	1	2.1
88	25-Jan-21	P197	EG Type IV Expansion	IP Mod/ZD	ClearWing EG	8	100	20	7.14%	-3.3	-6.7	-4.6	-10.1	75	-	13	-	20	2.95	2.6	5	1	1.05	4.5	1	1	2
89	26-Jan-21	P036	Type IV Validation and New Fluids	IP Mod/ZD	Polar Guard Xtend	8	100	20	6.59%	-3.36	-6.4	-4.7	-8.0	75	-	13	-	10	2.5	2.25	3	1	1.75	2	1	1	1.4
90	26-Jan-21	P085	EG Type IV Expansion	IP- / ZD	Safewing EG IV NORTH	8	100	20	6.93%	-1.66	-6.3	-4.5	-7.8	25	-	13	-	40	2.65	2.25	4.5	1	1	4.75	1	1	2.5
91	26-Jan-21	P112	EG Type IV Expansion	IP- / ZD	Defrost EG 4	8	100	20	3.91%	-1.55	-6.2	-4.4	-7.8	25	-	13	-	40	2.7	2.5	4.5	1	1	3.25	1	1	2.5
92	26-Jan-21	P193	EG Type IV Expansion	IP- / ZD	ClearWing EG	8	100	20	7.76%	-1.74	-6.1	-4.9	-7.5	25	-	13	-	40	2.65	2.5	5	1	1	5	1	1	5
93	26-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	1.30%	-1.52	-4.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
94	26-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	2.13%	-1.52	-4.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
95	26-Jan-21	P115	EG Type IV Expansion	IP Mod	Defrost EG 4	8	100	20	3.16%	-4.05	-4.5	-2.7	-9.9	75	-	-	-	35	2.75	2.55	4	1	1	1.05	1	1	1
96	26-Jan-21	P142	EG Type IV Expansion	IP Mod	ChemR EG IV	8	100	20	2.75%	-3.75	-4.5	-3.8	-9.3	75	-	-	-	35	3.25	2.75	4	1	1	1.15	1	1	1

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
97	27-Jan-21	P111	EG Type IV Expansion	IP- / SN-	Defrost EG 4	8	100	20	3.36%	-2.79	-4.4	-3.6	-9.4	25	10	-	-	50	2.75	2.5	4	1	1.05	1.35	1	1	1
98	27-Jan-21	P192	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	3.29%	-3.01	-4.2	-3.7	-8.6	25	10	-	-	50	3.4	2.5	4	1.15	1.15	1.75	1	1	1.75
99	27-Jan-21	P191	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	2.61%	-4.16	-4.3	-3.6	-7.9	25	-	-	-	70	2.8	2.5	4	1	1	1.05	1	1	1
100	27-Jan-21	P143	EG Type IV Expansion	IP Mod/ZD	ChemR EG IV	8	100	20	7.34%	-2.69	-4.6	-3.9	-9.5	75	-	13	-	20	3.05	2.55	4.5	1.1	1.05	4	1	1	2.5
101	27-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	1.24%	-3.97	-4.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
102	27-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	0.96%	-3.97	-4.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103	27-Jan-21	P056	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	1.30%	-5.39	-5.1	-3.8	-8.9	25	-	-	-	70	3	2.5	4	1	1	1	1	1	1
104	27-Jan-21	P164	EG Type IV Expansion	IP-	EG106	8	100	20	3.09%	-6.02	-6.1	-5.2	-9.4	25	-	-	-	70	2.6	2.4	4	1	1.05	1.3	1	1	1
105	28-Jan-21	P116	EG Type IV Expansion	IP Mod/ZD	Defrost EG 4	8	100	20	3.64%	-6.74	-7.1	-6.2	-10.9	75	-	13	-	20	2.7	2.5	4.5	1	1	2	1	1	1
106	28-Jan-21	P113	EG Type IV Expansion	IP- / ZR-	Defrost EG 4	8	100	20	5.83%	-6.68	-7.5	-7.3	-8.0	25	-	25	-	40	2.75	2.5	5	1	1	5	1	1	1
107	28-Jan-21	P140	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	7.07%	-7.51	-8.2	-7.1	-7.5	25	-	25	-	40	3.375	2.8	5	1.35	1.25	5	1.05	1.05	1.55
108	28-Jan-21	P140	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	8.03%	-9.02	-8.7	-7.4	-7.5	25	-	25	-	40	3	3	5	1.35	1.75	5	1.1	1.25	5

Log Of Tests Conducted with Thin High Performance Wing Section – RJ Wing (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
109	28-Jan-21	P001	Baseline	Dry Wing	none	8	100	20	0.00%	-14.4	-14.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
110	28-Jan-21	P002	Baseline	Dry Wing	none	22	80	20	1.72%	-14.4	-14.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
111	28-Jan-21	P045	Type IV Validation and New Fluids	IP- / SN-	Polar Guard Xtend	8	115	20	7.69%	-15.06	-15.2	-14.2	-14.5	25	10	-	-	15	2.5	2.3	3	1.05	1.75	2.25	1	1.2	1.6
112	28-Jan-21	P045	Type IV Validation and New Fluids	IP- / SN-	Polar Guard Xtend	8	115	20	8.37%	-15.25	-15.7	-14.2	-14.5	25	10	-	-	15	2.5	2.35	3.1	1.05	1.6	2.1	1	1.15	1.35
113	29-Jan-21	P044	Type IV Validation and New Fluids	IP-	Polar Guard Xtend	8	115	20	9.75%	-16.19	-16.3	-14.6	-15.8	25	-	-	-	30	2.5	2.3	3.25	1	2	2.1	1	1.15	1.3
114	29-Jan-21	P054	Type IV Validation and New Fluids	Fluid Only	Polar Guard Xtend	8	100	20	7.00%	-16.23	-16.8	-15.3	-13.0	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
115	29-Jan-21	P046	Type IV Validation and New Fluids	IP Mod	Polar Guard Xtend	8	115	20	9.79%	-16.72	-16.9	-5.2	-15.8	75	-	-	-	10	2.5	2.35	3.05	1	1.75	2.15	1	1.15	1.5
116	29-Jan-21	P046	Type IV Validation and New Fluids	IP Mod	Polar Guard Xtend	8	115	20	n/a	n/a	n/a	-15.2	n/a	75	-	-	-	5	2.4	2.2	3	n/a	n/a	n/a	n/a	n/a	n/a
117	29-Jan-21	P027	Type IV Validation and New Fluids	Fluid Only	ClearWing EG	8	100	20	5.23%	-16.8	-17.1	-15.7	-13.1	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

APPENDIX E

EG WIND TUNNEL DATA USED FOR ANALYSIS TO SUPPORT DEVELOPMENT OF AN EG ALLOWANCE TIME TABLE

Log of Tests for EG Analysis

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
21	20-Jan-10	**P004**	IP Validation	IP Mod	EG106	8	100	20	0.82%	-3.6	-5.9	N/A	-10.10	75	-	-	-	25	2.0	2.2	4.0	1.0	1.0	1.2	1.0	1.0	1.0
22	20-Jan-10	**P001**	IP Validation	IP-	EG106	8	100	20	0.86%	-4.1	-6.8	-4.30	-8.50	25	-	-	-	50	1.8	2.0	4.0	1.0	1.0	1.0	1.0	1.0	1.0
23	20-Jan-10	**P034**	IP Expansion	IP- / SN-	EG106	8	100	20	1.15%	-3.2	-6	-3.40	-9.00	25	10	-	-	40	2.3	2.2	4.0	1.0	1.2	1.5	1.0	1.0	1.0
26	21-Jan-10	**P007**	IP Validation	IP- / ZR-	EG106	8	100	20	4.14%	-1.9	-5.8	-3.10	-6.20	25	-	25	-	25	2.2	1.7	4.7	1.0	1.0	4.0	1.0	1.0	3.5
26A	21-Jan-10	**P007**	IP Validation	IP- / ZR-	EG106	8	100	0	1.29%	-3.3	-5.9	-2.80	-6.20	25	-	25	-	25	1.8	2.0	1.9	1.0	1.0	1.0	1.0	1.0	1.0
67	29-Jan-10	**P016**	IP Validation	IP-	EG106	8	100	20	1.06%	-12.6	-19.3	-14.70	-15.00	25	-	-	-	30	2.2	2.2	3.2	1.0	1.5	1.8	1.0	1.0	1.2
71	29-Jan-10	**P019/P031**	IP Validation	IP Mod	EG106	8	100	20	1.81%	-17.7	-21.4	-16.60	-17.20	75	-	-	-	10	2.3	2.3	2.8	1.0	1.3	1.8	1.0	1.0	1.2
80	30-Jan-10	**P028**	IP Validation	IP-	EG106	8	100	20	2.31%	-17	-22.9	-16.70	-18.50	25	-	-	-	30	2.5	2.2	3.0	1.0	1.3	1.7	1.0	1.0	1.0
98	02-Feb-10	**P022**	IP Validation	IP- / ZR-	EG106	8	100	20	1.20%	-6.7	-14.1	-9.50	-8.40	25	-	25	-	10	2.0	2.0	2.5	1.0	1.0	1.3	1.0	1.0	1.0
26	23-Jan-11	**P123**	IP Data Gap	IP Mod	EG106	8	100	20	3.07%	-21	-25.4	-21.00	-21.00	75	-	-	-	10	2.4	2.4	3.0	1.0	1.2	1.5	1.0	1.0	1.1
27	23-Jan-11	**P121**	IP Data Gap	IP-	EG106	8	100	20	3.21%	-22.6	-26.4	-20.50	-21.30	25	-	-	-	30	2.4	2.4	3.0	1.0	1.2	1.5	1.0	1.0	1.1
45	25-Jan-11	**P111**	IP Expansion	IP- / SN-	EG106	8	100	20	2.35%	-12.9	-19.4	-13.40	-15.70	25	10	-	-	15	2.3	2.0	3.0	1.0	1.1	1.3	1.0	1.0	1.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
51	25-Jan-11	**P023A**	Type IV Fluid Val.	IP-	EG106	8	100	20	1.64%	-11.1	-16.2	-8.00	-12.90	25	-	-	-	30	2.2	2.0	2.8	1.0	1.2	1.3	1.0	1.0	1.1
78	30-Jan-11	**P105**	IP Expansion	IP- / SN-	EG106	8	100	20	2.67%	-13.8	-16.3	-10.70	-14.20	25	10	-	-	25	2.7	2.2	4.0	1.0	1.6	1.8	1.0	1.0	1.2
126	8-Feb-11	**E16**	IP Expansion / CL Max	IP- / ZR-	EG106	18	100	20	7.24%	-10.1	-15.5	-11.60	-9.40	25	-	25	-	40	3.7	3.0	4.3	1.2	1.5	5.0	1.0	1.2	5.0
124	30-Jan-12	**E17**	Fluid Tests - Repeatibility	IP Mod	EG106	8	100	20	1.83%	-3.5	-9.8	-	-	75	-	-	-	25	2.4	2.2	3.8	1.0	1.1	1.2	1.0	1.0	1.0
125	30-Jan-12	**E17**	Fluid Tests - Repeatibility	IP Mod	EG106	18	100	20	1.69%	-4.1	-10.4	-	-	75	-	-	-	25	2.3	2.2	3.8	1.0	1.1	1.1	1.1	1.0	1.0
310	21-Jan-14	**P065**	IP Expansion	IP- / SN-	EG106	8	115	20	2.00%	-17.4	-23.1	-16.40	-18.66	25	10	-	-	15	1.7	1.7	2.3	1.0	1.3	1.5	1.0	1.1	1.3
311	21-Jan-14	**P065**	IP Expansion	IP- / SN-	EG106	8	100	20	4.06%	-18.1	-23.9	-21.00	-19.56	25	10	-	-	15	1.9	1.9	2.3	1.1	1.5	1.7	1.0	1.1	1.2
10	19-Jan-16	**P082**	Type IV Validation and New Fuids	IP-	LNT E450	8	100	20	5.82%	-15.2	-16.8	-14.52	-15.08	25	-	-	-	30	2.2	2.2	2.6	1.0	1.3	1.7	1.0	1.0	1.2
11	19-Jan-16	**P083**	Type IV Validation and New Fuids	IP Mod	LNT E450	8	100	20	5.97%	-16.8	-17.1	-14.72	-15.50	75	-	-	-	10	2.0	2.2	2.6	1.1	1.3	1.8	1.0	1.0	1.2
13	19-Jan-16	**P083**	Type IV Validation and New Fuids	IP Mod	LNT E450	8	100	20	6.43%	-15.4	-17	-14.57	-15.18	75	-	-	-	10	2.2	2.2	2.6	1.1	1.4	2.2	1.0	1.0	1.3
20	20-Jan-16	**P079**	Type IV Validation and New Fuids	IP- / ZR-	LNT E450	8	100	20	4.90%	-7.6	-8.9	-7.18	-7.77	25	-	25	-	10	1.8	2.0	2.0	1.0	1.1	1.5	1.0	1.0	1.0
21	20-Jan-16	**P080**	Type IV Validation and New Fuids	IP- / SN-	LNT E450	8	100	20	5.35%	-6.6	-9.2	-7.00	-2.22	25	10	-	-	15	1.7	2.0	2.4	1.0	1.4	1.7	1.0	1.0	1.2

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
68	25-Jan-16	**P073**	Type IV Validation and New Fuids	IP- / ZR-	LNT E450	8	100	20	3.11%	-1.3	-6.7	-3.25	-6.38	25	-	25	-	25	2.0	2.0	2.3	1.0	1.0	1.1	1.0	1.0	1.0
69	25-Jan-16	**P072**	Type IV Validation and New Fuids	IP Mod	LNT E450	8	100	20	3.30%	-2.0	-6.6	-2.57	-9.80	75	-	-	-	25	2.3	2.5	4.0	1.0	1.4	1.9	1.0	1.0	1.0
76	26-Jan-16	**P074**	Type IV Validation and New Fuids	IP- / R-	LNT E450	8	100	20	4.28%	0.0	-4	-0.98	-4.13	25	-	-	25	25	1.3	1.3	3.2	1.0	1.1	1.1	1.0	1.0	1.0
8	30-Jan-18	**P014**	Type IV Validation and New Fuids	IP- / ZR-	ChemR EG IV	8	100	20	3.21%	-8.2	-9.6	-7.87	-8.47	25	-	25	-	10	1.3	1.5	2.2	1.0	1.0	1.5	1.0	1.0	1.2
9	30-Jan-18	**P016**	Type IV Validation and New Fuids	IP Mod/ZD	ChemR EG IV	8	100	20	2.36%	-7.9	-9.4	-8.40	-11.33	75	-	13	-	7	1.5	1.7	2.3	1.0	1.2	1.5	1.0	1.0	1.2
12	30-Jan-18	**P012**	Type IV Validation and New Fuids	IP- / SN-	ChemR EG IV	8	100	20	2.48%	-7.8	-10.4	-7.83	-11.60	25	10	-	-	15	1.8	1.7	3.3	1.0	1.2	1.5	1.0	1.0	1.0
13	30-Jan-18	**P015**	Type IV Validation and New Fuids	IP Mod	ChemR EG IV	8	100	20	1.86%	-10.0	-11	-9.00	-13.07	75	-	-	-	10	1.8	2.0	2.3	1.0	1.3	1.5	1.0	1.0	1.2
16	30-Jan-18	**P017**	Type IV Validation and New Fuids	IP-	ChemR EG IV	8	100	20	2.60%	-13.3	-14.2	-11.97	-15.13	25	-	-	-	30	2.0	2.0	2.8	1.0	1.2	1.4	1.0	1.0	1.2
17	30-Jan-18	**P018**	Type IV Validation and New Fuids	IP- / SN-	ChemR EG IV	8	100	20	3.36%	-12.5	-15.2	-13.37	-15.23	25	10	-	-	15	2.0	2.0	2.8	1.0	1.3	1.5	1.0	1.0	1.2
18	31-Jan-18	**P019**	Type IV Validation and New Fuids	IP Mod	ChemR EG IV	8	100	20	2.71%	-14.8	-15.7	-13.77	-16.63	75	-	-	-	10	2.0	1.8	2.8	1.0	1.2	1.6	1.0	1.0	1.2
31	31-Jan-18	**P177**	EG Type IV Expansion	IP-	ChemR EG IV	8	100	20	1.80%	-8.7	-10.8	-8.70	-12.27	25	-	-	-	50	2.3	2.7	3.9	1.0	1.2	1.6	1.0	1.0	1.0
32	1-Feb-18	**P179**	EG Type IV Expansion	IP- / ZD	ChemR EG IV	8	100	20	5.43%	-6.4	-10.2	-8.17	-9.97	25	-	13	-	30	2.5	2.5	4.0	1.0	1.0	5.0	1.0	1.0	1.5

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
33	1-Feb-18	**P178**	EG Type IV Expansion	IP- / SN-	ChemR EG IV	8	100	20	3.68%	-5.2	-9.7	-7.10	-10.33	25	10	-	-	50	2.9	2.5	4.3	1.0	1.6	4.0	1.0	1.0	3.8
39	1-Feb-18	**P010**	Type IV Validation and New Fuids	IP Mod / R	ChemR EG IV	8	100	20	7.21%	-3.5	-4.2	-3.27	-7.00	75	-	-	75	10	2.2	2.2	4.7	1.0	1.0	5.0	1.0	1.0	5.0
40	1-Feb-18	**P003**	Type IV Validation and New Fuids	IP-	ChemR EG IV	8	100	20	1.28%	-6.8	-7.4	-4.70	-10.50	25	-	-	-	50	2.5	2.5	3.5	1.0	1.1	1.3	1.0	1.0	1.2
42	2-Feb-18	**P181**	EG Type IV Expansion	IP Mod	ChemR EG IV	8	100	20	2.29%	-10.5	-11	-8.80	-14.23	75	-	-	-	25	2.6	2.8	4.0	1.0	1.1	1.7	1.0	1.0	1.1
43	2-Feb-18	**P180**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	5.76%	-12.2	-13.3	-10.87	-10.70	25	-	25	-	30	3.3	2.8	5.0	1.8	1.1	5.0	1.0	1.0	5.0
15	22-Jan-19	**P020**	Type IV Validation and New Fluids	IP-	Max Flight AVIA	8	100	20	5.66%	-21.4	-21.2	-21.30	-22.60	25	-	-	-	30	2.0	2.0	3.0	1.0	1.7	2.0	1.0	1.0	1.1
16	22-Jan-19	**P021**	Type IV Validation and New Fluids	IP Mod	Max Flight AVIA	8	100	20	5.53%	-21.0	-21.1	-22.27	-23.10	75	-	-	-	10	2.0	2.0	2.7	1.0	1.5	2.0	1.0	1.0	1.1
17	22-Jan-19	**P124**	Type IV Validation and New Fluids	IP-	Defrost EG 4	8	100	20	6.72%	-22.0	-22.1	-21.63	-23.43	25	-	-	-	30	2.0	2.0	2.5	1.0	1.5	2.0	1.0	1.0	1.2
18	22-Jan-19	**P125**	Type IV Validation and New Fluids	IP Mod	Defrost EG 4	8	100	20	6.62%	-21.1	-21.7	-22.80	-22.70	75	-	-	-	10	2.0	2.0	2.7	1.0	1.4	2.1	1.0	1.0	1.2
31	23-Jan-19	**P008**	Type IV Validation and New Fluids	IP Mod	Max Flight AVIA	8	100	20	1.92%	-4.12	-4.9	-5.93	-13.67	75	-	-	-	25	2.3	2.5	3.5	1.0	1.0	1.1	1.0	1.0	1.0
32	23-Jan-19	**P112**	Type IV Validation and New Fluids	IP Mod	Defrost EG 4	8	100	20	2.49%	-3.86	-4.5	-5.83	-13.73	75	-	-	-	25	2.3	2.3	3.5	1.0	1.0	1.2	1.0	1.0	1.0
36	24-Jan-19	**P111**	Type IV Validation and New Fluids	IP- / R-	Defrost EG 4	8	100	20	1.44%	0.65	0.0	-1.90	-6.60	25	-	-	25	25	1.5	1.5	2.0	1.0	1.0	1.0	1.0	1.0	1.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
41	29-Jan-19	**P018**	Type IV Validation and New Fluids	IP- / SN-	Max Flight AVIA	8	100	20	4.33%	-13.95	-14.9	-16.17	-17.73	25	10	-	-	15	2.0	2.0	2.5	1.1	1.2	1.3	1.0	1.0	1.1
42	29-Jan-19	**P122**	Type IV Validation and New Fluids	IP- / SN-	Defrost EG 4	8	100	20	5.15%	-13.13	-13.7	-15.27	-16.97	25	10	-	-	15	2.5	2.5	2.8	1.0	1.1	1.3	1.0	1.0	1.1
43	29-Jan-19	**P118**	Type IV Validation and New Fluids	IP- / ZR-	Defrost EG 4	8	100	20	4.36%	-10.07	-12	-13.50	-13.70	25	-	25	-	10	2.0	2.0	2.5	1.0	1.0	1.2	1.0	1.0	1.0
46	30-Jan-19	**P014**	Type IV Validation and New Fluids	IP- / ZR-	Max Flight AVIA	8	100	20	2.95%	-10.31	-10.7	-14.30	-13.90	25	-	25	-	10	2.3	2.0	2.5	1.0	1.0	1.1	1.0	1.0	1.0
3	19-Jan-20	**P020**	Type IV Validation and New Fluids	IP Mod	Safewing EG IV NORTH	8	100	20	2.41%	-12.91	-12.3	-12.30	-17.28	75	-	-	-	10	2.2	1.9	3.3	1.0	1.0	1.5	1.0	1.0	1.0
4	19-Jan-20	**P018**	Type IV Validation and New Fluids	IP-	Safewing EG IV NORTH	8	100	20	2.48%	-13.84	-13.4	-13.30	-16.68	25	-	-	-	30	2.0	1.9	3.0	1.0	1.0	1.5	1.0	1.0	1.0
5	20-Jan-20	**P019**	Type IV Validation and New Fluids	IP- / SN-	Safewing EG IV NORTH	8	100	20	2.84%	-14.9	-14	-14.12	-16.52	25	10	-	-	15	2.0	1.9	2.9	1.0	1.1	1.5	1.0	1.0	1.0
6	20-Jan-20	**P073**	EG Type IV Expansion	IP Mod	Safewing EG IV NORTH	8	100	20	2.25%	-15.68	-14.7	-14.63	-18.53	75	-	-	-	25	3.1	3.0	4.0	1.0	1.1	2.4	1.0	1.0	1.0
7	20-Jan-20	**P071**	EG Type IV Expansion	IP-	Safewing EG IV NORTH	8	100	20	2.79%	-16.35	-15.7	-15.47	-18.09	25	-	-	-	50	2.3	2.1	4.0	1.0	1.1	1.7	1.0	1.0	1.1
11	20-Jan-20	**P127**	EG Type IV Expansion	IP Mod	ChemR EG IV	8	100	20	2.11%	-13.8	-12.5	-11.93	-17.25	75	-	-	-	25	3.3	2.7	4.0	1.0	1.4	1.7	1.0	1.1	1.1
12	20-Jan-20	**P126**	EG Type IV Expansion	IP- / SN-	ChemR EG IV	8	100	20	3.19%	-13.56	-13.4	-14.21	-16.53	25	10	-	-	30	2.4	2.4	4.0	1.0	1.7	2.1	1.0	1.1	1.3
13	20-Jan-20	**P154**	EG Type IV Expansion	IP Mod	EG106	8	100	20	1.09%	-15.47	-14.1	-14.56	-18.28	75	-	-	-	25	3.1	2.7	4.0	1.0	1.1	1.5	1.0	1.0	1.1

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
14	21-Jan-20	**P153**	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	1.95%	-14.39	-14.4	-14.77	-17.07	25	10	-	-	30	2.5	2.3	4.0	1.0	1.4	1.7	1.0	1.1	1.2
15	21-Jan-20	**P100**	EG Type IV Expansion	IP Mod	Defrost EG 4	8	100	20	2.83%	-15.65	-14.5	-14.90	-18.53	75	-	-	-	25	3.0	3.0	4.0	1.0	1.2	1.7	1.0	1.0	1.0
16	21-Jan-20	**P099**	EG Type IV Expansion	IP- / SN-	Defrost EG 4	8	100	20	3.42%	-15.11	-15.3	-15.40	-17.59	25	10	-	-	30	2.5	2.3	3.8	1.0	1.1	1.4	1.0	1.0	1.1
19	21-Jan-20	**P057**	EG Type IV Expansion	IP-	Safewing EG IV NORTH	8	100	20	0.83%	-5.34	-3.8	-5.76	-10.49	25	-	-	-	70	2.8	2.2	4.0	1.0	1.0	1.0	1.0	1.0	1.0
20	21-Jan-20	**P058**	EG Type IV Expansion	IP- / SN-	Safewing EG IV NORTH	8	100	20	1.53%	-4.67	-3.6	-5.77	-10.74	25	10	-	-	50	3.0	2.5	4.0	1.0	1.1	1.3	1.0	1.0	1.0
21	22-Jan-20	**P062**	EG Type IV Expansion	IP Mod	Safewing EG IV NORTH	8	100	20	1.27%	-5.44	-3.7	-6.06	-13.07	75	-	-	-	35	3.3	2.8	4.0	1.0	1.0	1.1	1.0	1.0	1.0
22	22-Jan-20	**P060**	EG Type IV Expansion	IP- / ZR-	Safewing EG IV NORTH	8	100	20	4.67%	-5.24	-3.8	-6.23	-8.01	25	-	25	-	40	3.0	2.2	5.0	1.0	1.0	5.0	1.0	1.0	5.0
23	22-Jan-20	**P063**	EG Type IV Expansion	IP Mod/ZD	Safewing EG IV NORTH	8	100	20	0.85%	-5.32	-3.6	-5.84	-11.55	75	-	13	-	20	3.0	2.6	4.0	1.0	1.0	1.4	1.0	1.0	1.0
10	11-Jan-21	**P004**	Type IV Validation and New Fluids	IP-	ClearWing EG	8	100	20	1.44%	-0.08	0.4	0.67	-5.27	25	-	-	-	50	2.0	1.6	3.8	1.0	1.0	1.1	1.0	1.0	1.0
13	12-Jan-21	**P198**	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	13.04%	-0.05	0	-0.47	-1.90	92	-	-	75	20	3.5	3.4	5.0	2.3	1.0	4.5	1.1	1.0	4.5
14	12-Jan-21	**P198**	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	7.14%	-0.61	-0.2	-0.50	-3.53	92	-	-	75	15	3.0	2.9	5.0	1.0	1.0	4.0	1.0	1.0	4.0
17	12-Jan-21	**P063**	EG Type IV Expansion	IP Mod / R	Max Flight AVIA	8	100	20	3.16%	0.13	0.4	1.23	-4.20	92	-	-	75	15	2.7	2.0	4.0	1.0	1.0	3.8	1.0	1.0	3.2

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
18	12-Jan-21	**P117**	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	5.42%	-0.26	0.2	-0.27	-5.10	92	-	-	75	15	2.0	1.4	5.0	1.0	1.0	4.0	1.0	1.0	3.9
19	12-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	11.74%	-0.67	0	-0.30	-4.27	92	-	-	75	15	2.7	2.9	5.0	1.0	1.0	4.5	1.0	1.0	4.5
20	13-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	0	5.90%	-0.61	-0.2	-0.20	-4.33	92	-	-	75	15	2.5	2.4	5.0	1.0	1.0	1.0	1.0	1.0	1.0
21	13-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	0	2.13%	-0.66	-0.4	0.23	-4.50	92	-	-	75	12	1.8	2.0	4.3	1.0	1.0	1.1	1.0	1.0	1.0
22	13-Jan-21	**P090**	EG Type IV Expansion	IP Mod / R	Safewing EG IV NORTH	8	100	20	6.66%	-0.57	-0.5	0.70	-3.57	92	-	-	75	15	3.2	3.0	5.0	1.0	1.1	4.0	1.0	1.0	4.0
23	13-Jan-21	**P195**	EG Type IV Expansion	IP- / R-	ClearWing EG	8	100	20	3.09%	-0.31	-0.7	0.00	-4.37	32	-	-	25	25	1.8	1.3	5.0	1.0	1.0	3.8	1.0	1.0	3.5
26	13-Jan-21	**P144**	EG Type IV Expansion	IP Mod / R	ChemR EG IV	8	100	20	2.33%	1.57	0.5	1.77	-2.43	92	-	-	75	15	2.9	2.5	4.0	1.0	1.0	3.0	1.0	1.0	1.5
27	13-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.13	0.7	1.40	-3.60	92	-	-	75	15	2.3	2.0	4.0	1.0	1.0	2.0	1.0	1.0	1.3
30	14-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.7	0.7	2.47	-3.60	75	-	-	75	20	2.7	2.4	4.0	1.0	1.0	1.6	1.0	1.0	1.0
31	15-Jan-21	**P171**	EG Type IV Expansion	IP Mod / R	EG106	8	100	20	1.85%	1.95	0.7	0.87	-4.27	75	-	-	75	15	1.4	2.0	3.5	1.0	1.0	1.3	1.0	1.0	1.0
32	15-Jan-21	**P198**	EG Type IV Expansion	IP Mod / R	ClearWing EG	8	100	20	1.03%	2.13	0.7	1.23	-1.80	75	-	-	75	20	3.0	2.9	4.0	1.0	1.0	1.2	1.0	1.0	1.1
33	15-Jan-21	**P117**	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	2.33%	1.21	0.6	1.33	-4.53	75	-	-	75	20	2.0	1.7	5.0	1.0	1.0	2.3	1.0	1.0	1.1

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
34	15-Jan-21	**P117**	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	0	1.58%	1.01	0.5	0.50	-4.47	75	-	-	75	20	2.0	1.7	5.0	1.0	1.0	1.2	1.0	1.0	1.0
35	15-Jan-21	**P117**	EG Type IV Expansion	IP Mod / R	Defrost EG 4	8	100	20	2.33%	1.08	0.4	0.37	-5.40	75	-	-	75	15	1.6	1.3	4.3	1.0	1.0	1.3	1.0	1.0	1.1
38	17-Jan-21	**P009**	Type IV Validation and New Fluids	IP Mod	ClearWing EG	8	100	20	1.99%	-5.07	-4.5	-3.60	-10.13	75	-	-	-	25	2.3	2.2	3.8	1.0	1.0	1.0	1.0	1.0	1.0
39	17-Jan-21	**P005**	Type IV Validation and New Fluids	IP- / SN-	ClearWing EG	8	100	20	2.81%	-4.98	-5	-5.37	-9.77	25	10	-	-	40	3.0	2.3	3.8	1.0	1.5	2.3	1.0	1.0	1.0
40	18-Jan-21	**P007**	Type IV Validation and New Fluids	IP- / ZR-	ClearWing EG	8	100	20	7.28%	-6.14	-5.8	-5.87	-7.50	25	-	25	-	25	2.5	2.1	5.0	1.0	1.0	5.0	1.0	1.0	5.0
41	18-Jan-21	**P007**	Type IV Validation and New Fluids	IP- / ZR-	ClearWing EG	8	100	0	1.65%	-6.49	-6.7	-5.70	-7.87	25	-	25	-	25	2.5	2.0	3.3	1.0	1.0	1.6	1.0	1.0	1.1
42	18-Jan-21	**P196**	EG Type IV Expansion	IP Mod	ClearWing EG	8	100	20	2.20%	-7.51	-7.3	-6.10	-11.50	75	-	-	-	35	3.5	2.9	4.0	1.0	8.1	1.8	1.0	1.0	1.1
48	19-Jan-21	**P064**	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	2.54%	-9.51	-9.53	-7.90	-12.23	25	-	-	-	50	2.0	2.0	3.5	1.0	1.0	1.3	1.0	1.0	1.0
49	19-Jan-21	**P199**	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	2.68%	-7.73	-9.8	-8.60	-11.57	25	-	-	-	50	2.1	2.0	3.7	1.0	1.1	1.4	1.0	1.0	1.0
50	19-Jan-21	**P176**	EG Type IV Expansion	IP Mod	EG106	8	100	20	2.20%	-7.8	-10.2	-7.70	-13.57	75	-	-	-	25	2.5	2.3	3.8	1.0	1.0	1.2	1.0	1.0	1.0
51	19-Jan-21	**P068**	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	3.29%	-8.71	-10.5	-8.90	-13.90	75	-	-	-	25	2.5	2.3	3.8	1.0	1.2	1.3	1.0	1.0	1.0
55	19-Jan-21	**P061**	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	2.06%	-6.21	-8.3	-5.57	-12.33	75	-	-	-	35	2.9	2.5	4.0	1.0	1.1	1.2	1.0	1.0	1.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate (g/dm^2/h)	SN Rate (g/dm^2/h)	ZR Rate (g/dm^2/h)	R Rate (g/dm^2/h)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
56	19-Jan-21	**P169**	EG Type IV Expansion	IP Mod	EG106	8	100	20	1.92%	-6.87	-8.5	-6.77	-12.10	75	-	-	-	35	3.0	2.5	4.0	1.0	1.0	1.1	1.0	1.0	1.0
57	20-Jan-21	**P137**	EG Type IV Expansion	IP-	ChemR EG IV	8	100	20	2.20%	-6.61	-8.5	-6.47	-9.70	25	-	-	-	70	3.0	2.5	4.0	1.0	1.1	1.1	1.0	1.0	1.0
58	20-Jan-21	**P110**	EG Type IV Expansion	IP-	Defrost EG 4	8	100	20	3.29%	-6.01	-8.2	-6.70	-10.43	25	-	-	-	70	2.5	2.3	3.7	1.0	1.0	1.1	1.0	1.0	1.0
59	20-Jan-21	**P059**	EG Type IV Expansion	IP- / ZR-	Max Flight AVIA	8	100	20	5.77%	-8.14	-8.2	-7.23	-8.30	25	-	25	-	40	3.0	2.5	5.0	1.2	1.2	5.0	1.0	1.0	2.0
62	20-Jan-21	**P065**	EG Type IV Expansion	IP- / SN-	Max Flight AVIA	8	100	20	3.36%	-9.37	-12.1	-10.20	-13.43	25	10	-	-	30	2.4	2.3	3.8	1.0	1.2	1.6	1.0	1.0	1.0
63	20-Jan-21	**P200**	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	4.87%	-9.27	-12.3	-10.13	-13.30	25	10	-	-	30	3.0	2.6	3.9	1.0	1.7	2.3	1.0	1.1	1.3
64	20-Jan-21	**P173**	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	3.64%	-9.59	-13	-10.10	-13.33	25	10	-	-	30	2.6	2.3	3.9	1.0	1.2	1.8	1.0	1.1	1.1
65	21-Jan-21	**P094**	EG Type IV Expansion	IP- / ZR-	Safewing EG IV NORTH	8	100	20	5.15%	-9.9	-13.1	-11.07	-10.33	25	-	25	-	30	3.0	2.3	5.0	1.0	1.0	5.0	1.0	1.0	5.0
66	21-Jan-21	**P067**	EG Type IV Expansion	IP- / ZR-	Max Flight AVIA	8	100	20	7.00%	-10.59	-13	-9.87	-10.10	25	-	25	-	30	2.8	2.4	5.0	1.0	1.1	5.0	1.0	1.0	5.0
67	21-Jan-21	**P148**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	7.48%	-10.58	-12.9	-9.53	-9.73	25	-	25	-	30	3.0	2.5	5.0	1.1	1.8	5.0	1.0	1.5	5.0
71	21-Jan-21	**P165**	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	3.16%	-3.68	-7.1	-5.33	-9.90	25	10	-	-	50	2.8	2.0	4.0	1.0	1.1	2.3	1.0	1.0	1.1
72	21-Jan-21	**P057**	EG Type IV Expansion	IP- / SN-	Max Flight AVIA	8	100	20	2.33%	-3.24	-5.7	-3.83	-9.40	25	10	-	-	50	3.0	2.5	4.0	1.0	1.2	1.5	1.0	1.0	1.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
73	22-Jan-21	**P194**	EG Type IV Expansion	IP- / ZR-	ClearWing EG	8	100	20	6.52%	-2.31	-4.5	-2.83	-5.87	25	-	25	-	40	3.0	2.5	5.0	1.0	1.0	5.0	1.0	1.0	5.0
74	22-Jan-21	**P140**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	9.88%	-1.88	-2.1	-2.20	-4.70	25	-	25	-	40	3.0	2.6	5.0	1.0	1.0	5.0	1.0	1.0	5.0
75	22-Jan-21	**P140**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	12.83%	-2.41	-2	-1.60	-4.73	25	-	25	-	35	2.8	2.2	5.0	1.0	1.0	5.0	1.0	1.0	5.0
76	22-Jan-21	**P140**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	0	2.26%	-3.42	-3.08	-2.47	-5.20	25	-	25	-	40	3.0	2.7	4.5	1.0	1.1	2.3	1.0	1.0	1.3
79	25-Jan-21	**P066**	EG Type IV Expansion	IP- / ZD	Max Flight AVIA	8	100	20	5.56%	-10.12	-12.1	-10.37	-11.30	25	-	13	-	30	3.0	2.9	5.0	1.0	1.0	5.0	1.0	1.0	5.0
80	25-Jan-21	**P201**	EG Type IV Expansion	IP- / ZD	ClearWing EG	8	100	20	6.73%	-8.96	-12.5	-10.70	-11.17	25	-	13	-	30	2.5	2.5	5.0	1.0	1.2	5.0	1.0	1.1	5.0
81	25-Jan-21	**P177**	EG Type IV Expansion	IP Mod/ZD	EG106	8	100	20	2.61%	-10.22	-12.4	-9.53	-12.87	75	-	13	-	10	2.6	2.5	3.5	1.0	1.1	1.3	1.0	1.1	1.1
82	25-Jan-21	**P096**	EG Type IV Expansion	IP Mod/ZD	Safewing EG IV NORTH	8	100	20	3.98%	-9.35	-11.94	-10.53	-13.43	75	-	13	-	15	3.0	3.0	4.0	1.0	1.1	2.5	1.0	1.0	1.4
83	25-Jan-21	**P069**	EG Type IV Expansion	IP Mod/ZD	Max Flight AVIA	8	100	20	3.36%	-9.48	-11.8	-10.07	-13.30	75	-	13	-	15	2.8	2.7	4.0	1.0	1.1	1.5	1.0	1.0	1.1
86	25-Jan-21	**P062**	EG Type IV Expansion	IP Mod/ZD	Max Flight AVIA	8	100	20	3.57%	-3.91	-7.2	-5.67	-10.83	75	-	13	-	20	2.7	2.5	4.0	1.0	1.0	2.5	1.0	1.0	1.0
87	25-Jan-21	**P170**	EG Type IV Expansion	IP Mod/ZD	EG106	8	100	20	7.41%	-4.3	-6.8	-5.47	-10.27	75	-	13	-	25	2.5	2.5	5.0	1.0	1.1	5.0	1.0	1.0	2.1
88	25-Jan-21	**P197**	EG Type IV Expansion	IP Mod/ZD	ClearWing EG	8	100	20	7.14%	-3.3	-6.7	-4.63	-10.13	75	-	13	-	20	3.0	2.6	5.0	1.0	1.1	4.5	1.0	1.0	2.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	Test Plan #	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	Corrected for 3D Effects % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
90	26-Jan-21	**P085**	EG Type IV Expansion	IP- / ZD	Safewing EG IV NORTH	8	100	20	6.93%	-1.66	-6.3	-4.53	-7.83	25	-	13	-	40	2.7	2.3	4.5	1.0	1.0	4.8	1.0	1.0	2.5
91	26-Jan-21	**P112**	EG Type IV Expansion	IP- / ZD	Defrost EG 4	8	100	20	3.91%	-1.55	-6.2	-4.43	-7.83	25	-	13	-	40	2.7	2.5	4.5	1.0	1.0	3.3	1.0	1.0	2.5
92	26-Jan-21	**P193**	EG Type IV Expansion	IP- / ZD	ClearWing EG	8	100	20	7.76%	-1.74	-6.1	-4.87	-7.47	25	-	13	-	40	2.7	2.5	5.0	1.0	1.0	5.0	1.0	1.0	5.0
95	26-Jan-21	**P115**	EG Type IV Expansion	IP Mod	Defrost EG 4	8	100	20	3.16%	-4.05	-4.5	-2.73	-9.93	75	-	-	-	35	2.8	2.6	4.0	1.0	1.0	1.1	1.0	1.0	1.0
96	26-Jan-21	**P142**	EG Type IV Expansion	IP Mod	ChemR EG IV	8	100	20	2.75%	-3.75	-4.5	-3.80	-9.33	75	-	-	-	35	3.3	2.8	4.0	1.0	1.0	1.2	1.0	1.0	1.0
97	27-Jan-21	**P111**	EG Type IV Expansion	IP- / SN-	Defrost EG 4	8	100	20	3.36%	-2.79	-4.4	-3.60	-9.37	25	10	-	-	50	2.8	2.5	4.0	1.0	1.1	1.4	1.0	1.0	1.0
98	27-Jan-21	**P192**	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	3.29%	-3.01	-4.2	-3.67	-8.60	25	10	-	-	50	3.4	2.5	4.0	1.2	1.2	1.8	1.0	1.0	1.8
99	27-Jan-21	**P191**	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	2.61%	-4.16	-4.3	-3.63	-7.93	25	-	-	-	70	2.8	2.5	4.0	1.0	1.0	1.1	1.0	1.0	1.0
100	27-Jan-21	**P143**	EG Type IV Expansion	IP Mod/ZD	ChemR EG IV	8	100	20	7.34%	-2.69	-4.6	-3.87	-9.54	75	-	13	-	20	3.1	2.6	4.5	1.1	1.1	4.0	1.0	1.0	2.5
103	27-Jan-21	**P056**	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	1.30%	-5.39	-5.1	-3.83	-8.93	25	-	-	-	70	3.0	2.5	4.0	1.0	1.0	1.0	1.0	1.0	1.0
104	27-Jan-21	**P164**	EG Type IV Expansion	IP-	EG106	8	100	20	3.09%	-6.02	-6.1	-5.17	-9.37	25	-	-	-	70	2.6	2.4	4.0	1.0	1.1	1.3	1.0	1.0	1.0
105	28-Jan-21	**P116**	EG Type IV Expansion	IP Mod/ZD	Defrost EG 4	8	100	20	3.64%	-6.74	-7.1	-6.20	-10.87	75	-	13	-	20	2.7	2.5	4.5	1.0	1.0	2.0	1.0	1.0	1.0

Log of Tests for EG Analysis (cont'd)

Test #	Date	**Test Plan #**	Objective	Test Condition	Fluid Name	Rotation Angle	Speed Kts	Flap Angle (0°, 20°)	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	AVG Wing Temp. Before Fluid Appl. (°C)	AVG Wing Temp. Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	R Rate ($g/dm^2/h$)	Exposure Time (min)	Rating Before Take-Off Run LE	Rating Before Take-Off Run TE	Rating Before Take-Off Run Flap	Rating At Rotation LE	Rating At Rotation TE	Rating At Rotation Flap	Rating After Take-Off Run LE	Rating After Take-Off Run TE	Rating After Take-Off Run Flap
106	28-Jan-21	**P113**	EG Type IV Expansion	IP- / ZR-	Defrost EG 4	8	100	20	5.83%	-6.68	-7.5	-7.27	-8.03	25	-	25	-	40	2.8	2.5	5.0	1.0	1.0	5.0	1.0	1.0	1.0
107	28-Jan-21	**P140**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	7.07%	-7.51	-8.2	-7.10	-7.53	25	-	25	-	40	3.4	2.8	5.0	1.4	1.3	5.0	1.1	1.1	1.6
108	28-Jan-21	**P140**	EG Type IV Expansion	IP- / ZR-	ChemR EG IV	8	100	20	8.03%	-9.02	-8.7	-7.43	-7.47	25	-	25	-	40	3.0	3.0	5.0	1.4	1.8	5.0	1.1	1.3	5.0