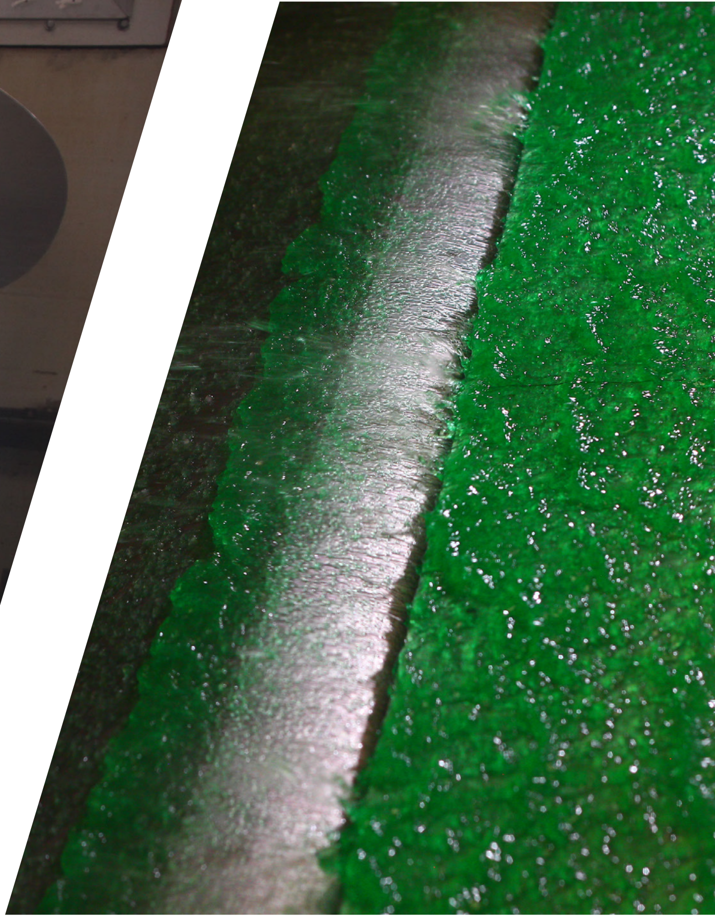


WIND TUNNEL TRIALS TO SUPPORT FURTHER DEVELOPMENT OF ICE PELLET ALLOWANCE TIMES: WINTER 2021-22

AiPS Aviation Inc.

TP 15537E
Final Version 1.0
November 2022

Prepared for:

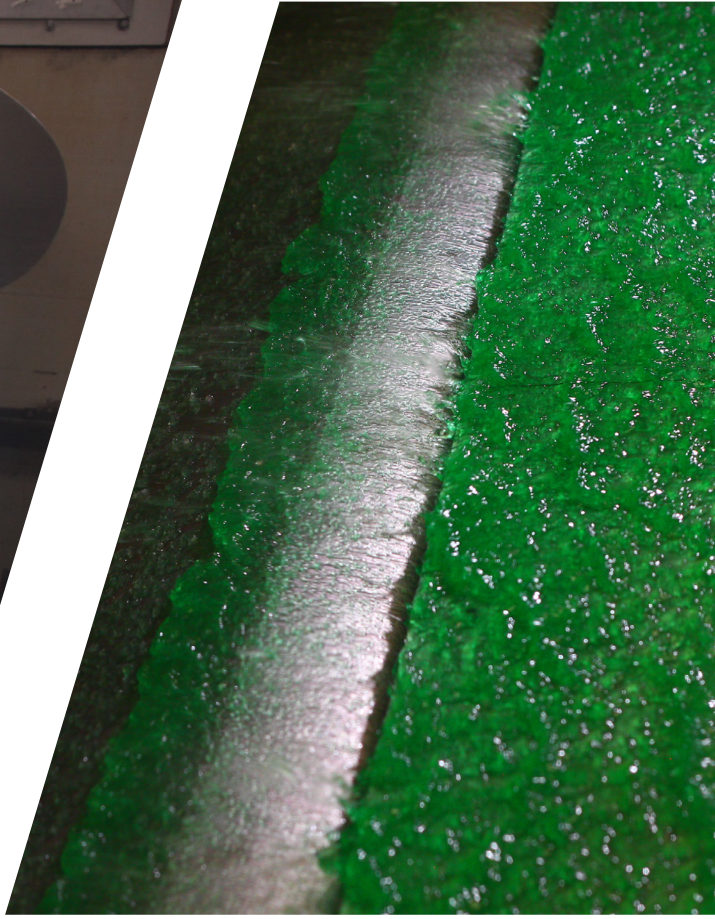
Transport Canada
Programs Group
Innovation Centre

In cooperation with:

Federal Aviation Administration
William J. Hughes Technical Center

Transport Canada
Civil Aviation

Federal Aviation Administration
Flight Standards – Air Carrier Operations



WIND TUNNEL TRIALS TO SUPPORT FURTHER DEVELOPMENT OF ICE PELLET ALLOWANCE TIMES: WINTER 2021-22

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Prepared by

Marco Ruggi

The contents of this report reflect the views of APS Aviation Inc. and not necessarily the official view or opinions of the Transport Canada Programs Group Innovation Centre or the co-sponsoring organizations.

Neither the Transport Canada Programs Group Innovation Centre nor the co-sponsoring organizations endorse the products or manufacturers. Trade or manufacturers' names appear in this report only because they are essential to its objectives.

DOCUMENT ORIGIN AND APPROVAL RECORD

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Un sommaire français se trouve avant la table des matières.

This report was first provided to Transport Canada as Final Draft 1.0 in November 2022.
It has been published as Final Version 1.0 in April 2023.

PREFACE

Under contract to the Transport Canada Programs Group 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 conduct wind tunnel testing with a vertical stabilizer common research model to evaluate contaminated fluid flow-off before and after a simulated takeoff;
- To conduct comparative endurance time testing and evaluate endurance times in mixed snow and freezing fog conditions;
- To conduct general and exploratory de/anti-icing research;
- To conduct analysis to support harmonization of the Transport Canada and the Federal Aviation Administration visibility table guidance;
- 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.

The research activities of the program conducted on behalf of Transport Canada during the winter of 2021-22 are documented in seven reports. The titles of the reports are as follows:

- TP 15534E — Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2021-22 Winter;
- TP 15535E — Regression Coefficients and Equations Used to Develop the Winter 2022-23 Aircraft Ground Deicing Holdover Time Tables;
- TP 15536E — Aircraft Ground Icing General Research Activities During the 2021-22 Winter;
- TP 15537E — Wind Tunnel Trials to Support Further Development of Ice Pellet Allowance Times: Winter 2021-22;
- TP 15538E — Wind Tunnel Testing to Evaluate Contaminated Fluid Flow-Off from a Common Research Model Vertical Stabilizer;

- TP 15539E Artificial Snow Research Activities for the 2020-21 and 2021-22 Winters; and
- TP 15540E Evaluation of Fluid Endurance Times in Mixed Snow and Freezing Fog Conditions.

This report, TP 15537E, 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 Programs Group 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, Steve Baker, David Beals, Stephanie Bendickson, Benjamin Bernier, Chloë Bernier, Christopher D'Avirro, John D'Avirro, Peter Dawson, Francine De Ladurantaye, Sean Devine, Ali Etemad, Noemie Gokhool, Kyra Kinderman-McCormick, Peter Kitchener, Diana Lalla, Shahdad Movaffagh, Shamim Nakhaei, William Ethan Payne, Dany Posteraro, Alex K. Raymond, Annaelle Reuveni, Marco Ruggi, Javad Safari, Alexa-Kiran Sareen-Diacoumacos, Niroshaan Sivarajah, Saba Tariq, Nicole Thomson, and Ian Wittmeyer.

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 15537E	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 2021-22		5. Publication Date November 2022 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 Montreal, Quebec, H4T 2B5		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 Programs Group Innovation Centre 330 Sparks St., 18th Floor Ottawa, Ontario, K1A 0N5		13. Type of Publication and Period Covered Final 14. Project Officer Antoine Lacroix

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 Programs Group 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, APS Aviation Inc. (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.

A wind tunnel testing program was developed for the winter of 2021-22 with the primary objectives of conducting aerodynamic testing to substantiate the current Type IV fluid Ice Pellet Allowance Times with new fluids, extend the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol fluids, expansion of the current allowance times, and re-validate the lift loss scaling analysis.

The wind tunnel testing conducted during the winter of 2021-22 validated the current Type IV allowance times for use with the new-to-market fluids: CHEMCO Inc. ChemR Nordik IV, Cryotech Deicing Technology Polar Guard® Xtend, JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical Co. Ltd. FCY-EGIV. Validation testing for AllClear ClearWing ECO is considered incomplete and more testing is recommended.

As a result of the recent data, and supported by historical data, a guidance change was recommended to reduce the PG fluid 30-minute allowance time to 20-minutes for light ice pellets, below -16ºC to -22ºC. Based on the data collected, Transport Canada (TC) and the Federal Aviation Administration (FAA) agreed to update the separate Type IV EG fluid allowance time table to incorporate longer times in the below -10ºC to -16ºC range.

Data was collected in the mixed conditions moderate ice pellets and moderate snow as well as light ice pellets, light snow, and light freezing rain, and although limited, indicated a potential for future development. The lift loss scaling analysis was verified with 18 new data points.

The proposed changes were updated in the respective allowance time tables and the notes in the respective tables were updated to reflect the content changes. Through consultations with TC, the FAA, and National Aeronautics and Space Administration (NASA) and based on industry discussions, higher priority areas of possible future wind tunnel testing and research have been identified, including substantiation of ice pellet allowance times with new fluids, allowance time expansion, and development of Type III mid-speed allowance times.

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 Programs Group Innovation Centre		
19. Security Classification (of this publication) Unclassified	20. Security Classification (of this page) Unclassified	21. Declassification (date)	22. No. of Pages xvi, 88 apps	23. Price

CDT/TDC 79-005
Rev. 96

Canada

Transports Canada | Transport Canada

FORMULE DE DONNÉES POUR PUBLICATION

1. No de la publication de Transports Canada: TP 15537E

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 2021-22

5. Date de la publication: Novembre 2022

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:
APS Aviation Inc.
6700, Chemin de la Côte-de-Liesse, Bureau 102
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 du groupe de programmes
330, rue Sparks, 18ième étage
Ottawa (Ontario) K1A 0N5

13. Genre de publication et période visée: Final

14. Agent de projet: Antoine Lacroix

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 du groupe de programmes 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, APS Aviation inc. (APS) 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 des liquides 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 2021-2022 avec comme principaux objectifs de réaliser des tests d'aérodynamisme visant à corroborer les marges de tolérance actuelles pour les granules de glace avec de nouveaux liquides de type IV, à élargir les marges de tolérance actuelles dans des conditions de granules de glace pour les liquides de type IV à base d'éthylène glycol, à élargir les marges de tolérance actuelles et à revalider l'analyse relative à l'échelle des pertes de portance.

Les essais menés en soufflerie au cours de l'hiver 2021-2022 ont confirmé l'applicabilité des marges de tolérance actuelles des liquides de type IV aux produits nouvellement commercialisés : CHEMCO Inc. ChemR Nordik IV, Cryotech Deicing Technology Polar Guard® Xtend, JSC RCP Nordix Defrost NORTH 4, et Newave Aerochemical Co. Ltd. FCY-EGIV. Les essais de validation pour AllClear ClearWing ECO ont été jugés incomplets; il est donc recommandé de procéder à des évaluations supplémentaires.

En réponse aux données récentes et en prenant appui sur les données historiques, on recommande de modifier les lignes directrices sur les marges de tolérance applicables aux liquides à base de propylène glycol pour les faire passer de 30 minutes à 20 minutes, lors de conditions de précipitations faibles de granules de glace à des températures au-dessous de -16 °C à -22 °C. À la lumière des données recueillies, Transports Canada (TC) et la Federal Aviation Administration (FAA) ont convenu de réviser les différents tableaux de marges de tolérance applicables aux liquides à base d'éthylène glycol de type IV pour y incorporer des durées prolongées lors de températures au-dessous de -10 °C à -16 °C.

Les données ont été recueillies dans des conditions mixtes de précipitations modérées de granules de glace et de neige, de même que des précipitations faibles de granules de glace, de neige et de pluie verglaçante, et malgré leur caractère limité, elles laissent entrevoir la possibilité de développement futur. L'analyse de l'échelle des pertes de portance a été vérifiée en fonction de 18 nouveaux points de données.

Les modifications proposées ont été incorporées aux tableaux respectifs des marges de tolérance, et les notes associées à ces derniers ont été mises à jour pour refléter ces changements. Par l'entremise de consultations auprès de TC, de la FAA et de la National Aeronautics and Space Administration (NASA) et à partir de discussions avec les parties prenantes du secteur, des domaines de priorité supérieure ont été définis pour encadrer les potentiels essais et travaux de recherche en soufflerie, notamment en ce qui a trait à la corroboration des marges de tolérance applicables aux nouveaux liquides dans des conditions de granules de glace, à l'élargissement des marges de tolérance et à la mise au point de marges de tolérance pour les liquides de type III sur des aéronefs à vitesse moyenne.

17. Mots clés: Granule de glace, marge de tolérance, rotation à vitesse élevée, rotation à faible vitesse, type II, type III, type IV, adhérence des liquides, ruissellement des liquides, soufflerie, soufflerie de givrage, comportement aérodynamique des ailes

18. Diffusion: Disponible auprès du Centre d'innovation du groupe de programmes de Transports Canada

19. Classification de sécurité (de cette publication)	20. Classification de sécurité (de cette page)	21. Déclassification (date)	22. Nombre de pages	23. Prix
Non classifiée	Non classifiée		xvi, 88 ann.	

CDT/TDC 79-005
Rev. 96

Canada

EXECUTIVE SUMMARY

Under contract to the Transport Canada (TC) Programs Group 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 2021-22 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 2021-22 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);
- Extend the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol (EG) fluids using the thin high-performance RJ airfoil;
- General expansion of the current allowance times to include new temperature bands, new conditions, and mixed conditions for propylene glycol (PG) and EG Type IV fluids; and
- Re-validation of the lift loss scaling analysis which provides the basis for the aerodynamic evaluation criteria used for allowance time testing with the RJ wing.

Conclusions and Recommendations

The wind tunnel testing conducted during the winter of 2021-22 validated the current Type IV allowance times for use with the new-to-market fluids: CHEMCO Inc. ChemR Nordik IV, Cryotech Deicing Technology Polar Guard® Xtend, JSC RCP Nordix Defrost NORTH 4, and Newave Aerochemical Co. Ltd. FCY-EGIV. Validation testing for AllClear ClearWing ECO is considered incomplete and more testing is recommended.

As a result of the recent data, and supported by historical data, a guidance change was recommended to reduce the PG fluid 30-minute allowance time to 20-minutes for light ice pellets, below -16°C to -22°C. Based on the data collected, TC and the FAA updated the separate Type IV EG fluid allowance time table to incorporate longer times in the below -10°C to -16°C range.

Data was collected in the mixed conditions moderate ice pellets and moderate snow as well as light ice pellets, light snow, and light freezing rain, and although limited, indicated a potential for future development. The lift loss scaling analysis was verified with 18 new data points.

The proposed changes were updated in the respective allowance time tables and the notes in the respective tables were updated to reflect the content changes. Through consultations with TC, the FAA, and National Aeronautics and Space Administration (NASA) and based on industry discussions, higher priority areas of possible future wind tunnel testing and research have been identified, including substantiation of ice pellet allowance times with new fluids, allowance time expansion, and development of Type III mid-speed allowance times.

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 2021-2022 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 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 objectifs

Un programme d'essais en soufflerie a été mis au point pour l'hiver 2021-2022 avec comme principaux objectifs de mener des tests d'aérodynamisme 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 (LOUT);
- élargir les marges de tolérance actuelles dans des conditions de granules de glace pour les liquides de type IV à base d'éthylène glycol (EG) au moyen d'une surface portante haute performance à profil mince d'un avion de transport régional à réaction;
- élargir de manière générale les marges de tolérance actuelles pour y inclure de nouvelles plages de température, de nouvelles conditions météorologiques ainsi que des contextes de conditions mixtes encadrant l'utilisation de liquides de type IV à base de propylène glycol (PG) et d'EG ; et
- revalider l'analyse relative à l'échelle des pertes de portance qui sert de base aux critères d'évaluation de l'aérodynamisme utilisés lors d'essais sur les marges de tolérance sur aile de jet régional.

Conclusions et recommandations

Les essais menés en soufflerie au cours de l'hiver 2021-2022 ont confirmé l'applicabilité des marges de tolérance actuelles des liquides de type IV aux produits nouvellement commercialisés : CHEMCO Inc. ChemR Nordik IV, Cryotech Deicing Technology Polar Guard® Xtend, JSC RCP Nordix Defrost NORTH 4, et Newave Aerochemical Co. Ltd. FCY-EGIV. Les essais de validation pour AllClear ClearWing ECO ont été jugés incomplets; il est donc recommandé de procéder à des évaluations supplémentaires.

En réponse aux données récentes et en prenant appui sur les données historiques, on recommande de modifier les lignes directrices sur les marges de tolérance applicables aux liquides à base de propylène glycol pour les faire passer de 30 minutes à 20 minutes, lors de conditions de précipitations faibles de granules de glace à des températures au-dessous de -16 °C à -22 °C. À la lumière des données recueillies, TC et la FAA ont mis à jour les différents tableaux de marges de tolérance applicables aux liquides à base d'éthylène glycol de type IV pour y incorporer des durées prolongées lors de températures au-dessous de -10 °C à -16 °C.

Les données ont été recueillies dans des conditions mixtes de précipitations modérées de granules de glace et de neige, de même que des précipitations faibles de granules de glace, de neige et de pluie verglaçante, et malgré leur caractère limité, elles laissent entrevoir la possibilité de développement futur. L'analyse de l'échelle des pertes de portance a été vérifiée en fonction de 18 nouveaux points de données.

Les modifications proposées ont été incorporées aux tableaux respectifs des marges de tolérance, et les notes associées à ces derniers ont été mises à jour pour refléter ces changements. Par l'entremise de consultations auprès de TC, de la FAA et de la National Aeronautics and Space Administration (NASA) et à partir de discussions avec les parties prenantes du secteur, des domaines de priorité supérieure ont été définis pour encadrer les potentiels essais et travaux de recherche en soufflerie, notamment en ce qui a trait à la corroboration des marges de tolérance applicables aux nouveaux liquides dans des conditions de granules de glace, à l'élargissement des marges de tolérance et à la mise au point de marges de tolérance pour les liquides de type III sur des aéronefs à vitesse moyenne.

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GLOSSARY

AMIL	Anti-Icing Materials International Laboratory
APS	APS Aviation Inc.
AWG	G-12 Aerodynamics Working Group
BLDT	Boundary Layer Displacement Thickness
CCTV	Closed-Circuit Television System
EG	Ethylene Glycol
FAA	Federal Aviation Administration
HOT	Holdover Time
IWT	3 m x 6 m Icing Wind Tunnel
LE	Leading Edge
LOUT	Lowest Operational Use Temperature
MID	Mid-Chord
NASA	National Aeronautics and Space Administration
NRC	National Research Council Canada
OAT	Outside Air Temperature
PG	Propylene Glycol
RJ	Regional Jet
RTD	Resistance Temperature Detector
SAE	SAE International
TC	Transport Canada
TE	Trailing Edge
UND	Under-Wing

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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 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 freezing point depressant 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, enhance safety, and advance 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 Programs Group 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 2021-22 in support of the aircraft ground icing research program. Each major project completed as part of the 2021-22 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 (NASA) and the NRC that focused on the extensive calibration and characterization work performed with a generic thin high-performance airfoil. This work helped increase confidence in how the data was used to 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 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 examining 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 no testing was therefore 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 2021-22, 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 2021-22 with the primary objectives of conducting aerodynamic testing to accomplish the following:

- Substantiating 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);
- Extending the current Type IV fluid Ice Pellet Allowance Times for ethylene glycol (EG) fluids using the thin high-performance RJ airfoil;
- Expanding the current allowance times to include new temperature bands, new conditions, and mixed conditions for propylene glycol (PG) and EG Type IV fluids; and
- Re-validating the lift loss scaling analysis, which provides the basis for the aerodynamic evaluation criteria used for allowance time testing with the RJ wing.

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 2021-22 on the RJ wing. It should be noted that as part of the TC/FAA wind tunnel research plan for 2021-22, a new preliminary test program attempted to document fluid flow-off on a common research model vertical stabilizer, the results of which are documented in a separate report.

Table 1.1: Summary of 2021-22 RJ Wing Tests by Objective

Objective #	Objective	# of Runs
1	Baseline Tests (Dry Wing)	36
2	Ice Pellet Allowance Time Validation (New Fluids)	53
3	EG Fluids – Expansion of Allowance Times	28*
4	General Expansion (New Mixed Conditions)	12
	Total	***129***

*23 of 28 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. For the winter of 2021-22, the Type IV table was separated into two tables for EG and PG Type IV fluids. Each year the Type IV testing has built upon the latest version of the allowance time tables 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 been available and published only 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;
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 results from the research aimed at general allowance time expansion for mixed conditions;
f) Section 7 describes the process and results from the re-validation of the lift loss scaling analysis;
g) Section 8 describes the general changes to the Ice Pellet Allowance Time Tables that resulted from the research conducted this year;
h) Section 9 provides a summary of the conclusions; and
i) Section 10 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 9, 2022. 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: 2021-22 Calendar of Tests

Date (Start date of overnight)	**# of Tests Run**
January 9, 2022	8
January 10, 2022	12
January 11, 2022	9
January 12, 2022	6
January 13, 2022	9
January 16, 2022	7
January 17, 2022	8
January 18, 2022	10
January 19, 2022	8
January 20, 2022	8
January 23, 2022	9
January 24, 2022	10
January 25, 2022	9
January 26, 2022	10
January 27, 2022	6
Total	**129**

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.

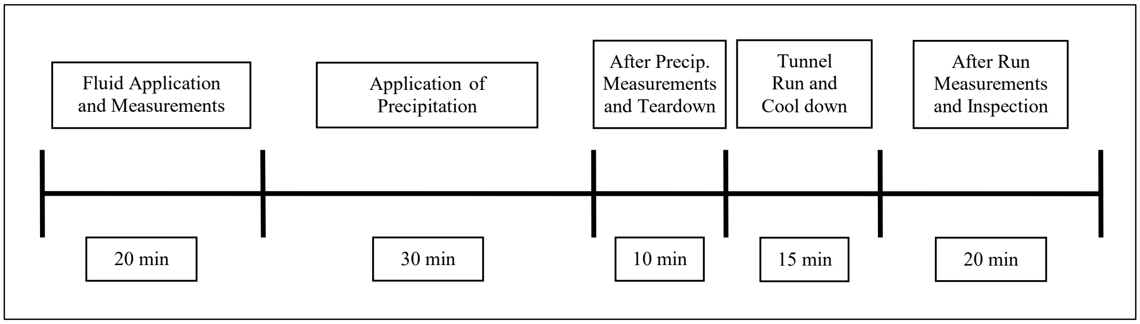

Figure 2.1: Typical Wind Tunnel Test Timeline

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, or for exploring new conditions.

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.

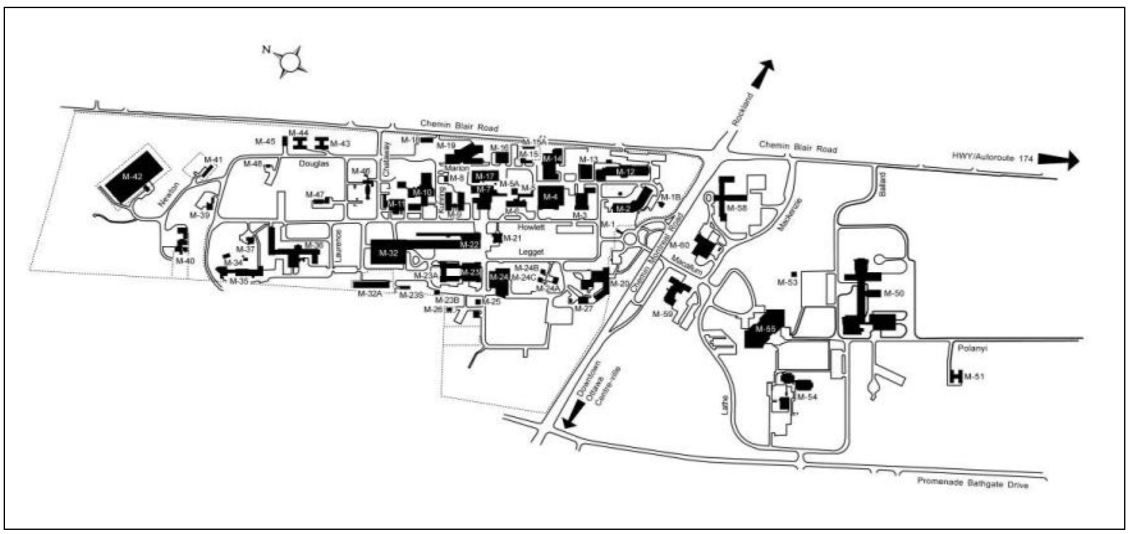

Figure 2.2: Schematic of NRC Montreal Road Campus

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. 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.).

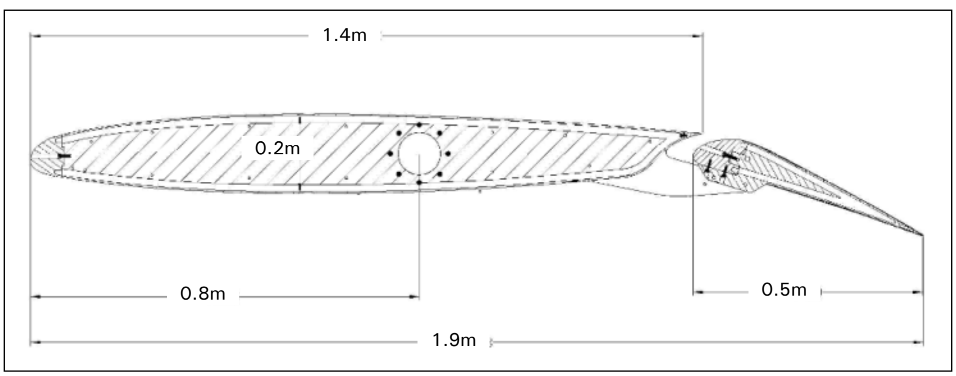

Figure 2.3: Generic "Thin High-Performance" Wing Section

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 2º when sitting on the ground. As a result, the NRC ensured the rest position of the wing model was set to -2º for each test.

The wing section was fitted with a hinged flap. The flap position was fixed at 20º 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 20º created close to a

26º slope on the top surface of the flap (with the wing pitched forward by 2º). As testing progressed, the ability to change the flap setting from 0º to 20º 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 0º and 20º for the fluid application and contamination periods; however, all takeoff simulations were conducted with the flap set to 20º. 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.)

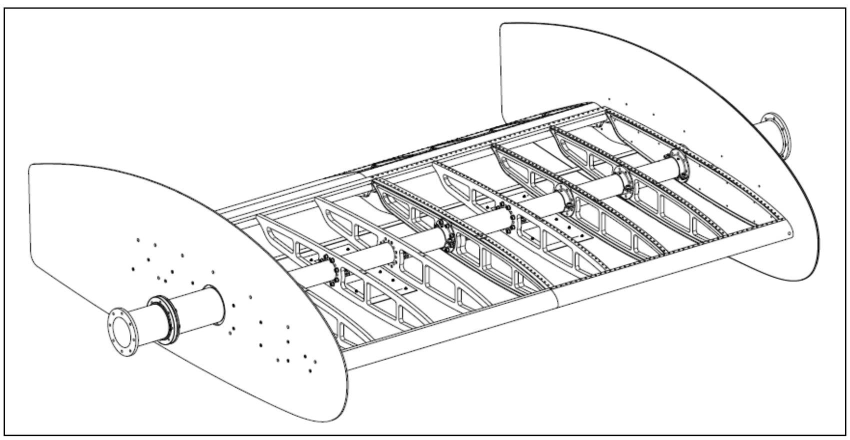

Figure 2.4: End Plates Installed on Thin High-Performance Wing Section

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.

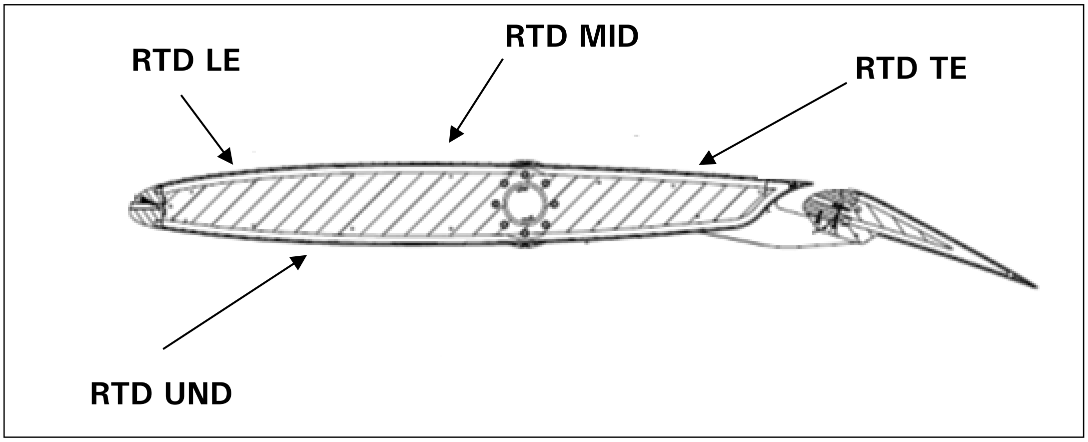

Figure 2.5: Location of RTDs Installed Inside Thin High-Performance Wing

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 testing conducted during the winter of 2021-22:

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 $g/dm^2/h$.

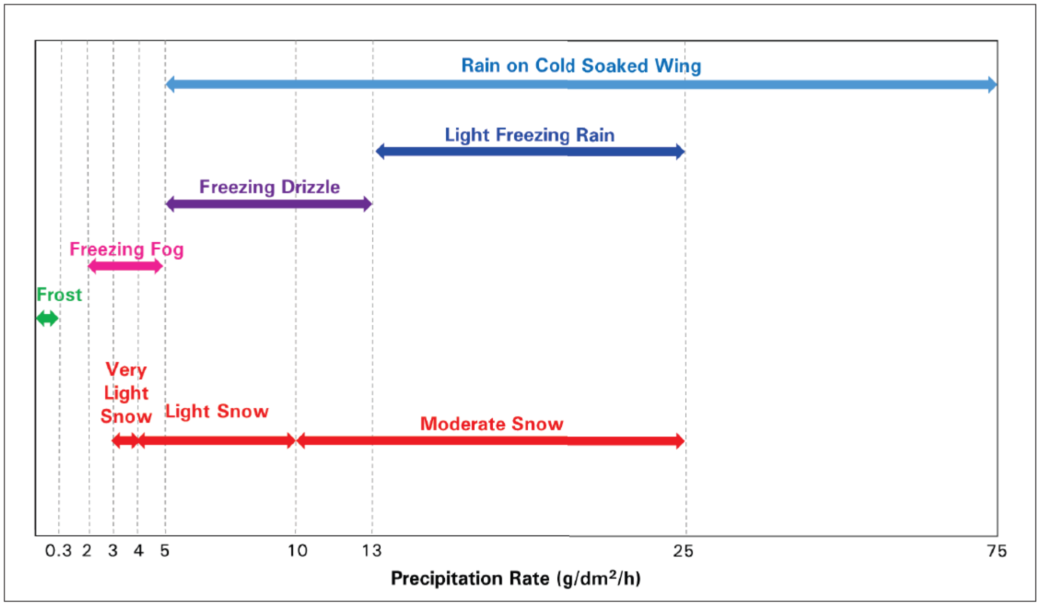

Figure 2.6: Precipitation Rate Breakdown

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 Godox SL150W II LED video lights to capture second-by-second photography with an intervalometer. An Osmo® camera was used for wide-angle filming of fluid flow-off during the test runs.

Due to facility occupancy and travel restrictions, 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.

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.

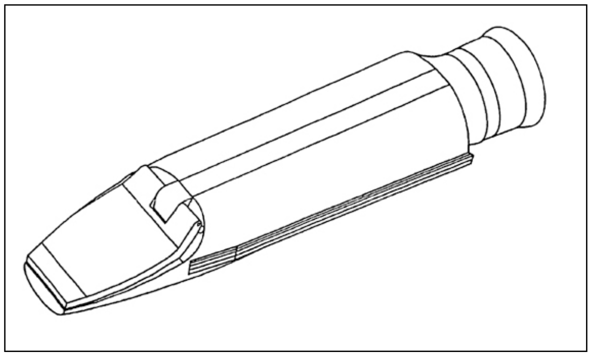

Figure 2.7: Hand-Held Refractometer/Brixometer

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.

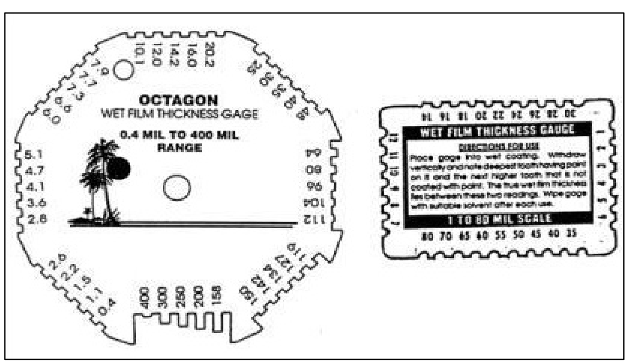

Figure 2.8: Wet Film Thickness Gauges

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.

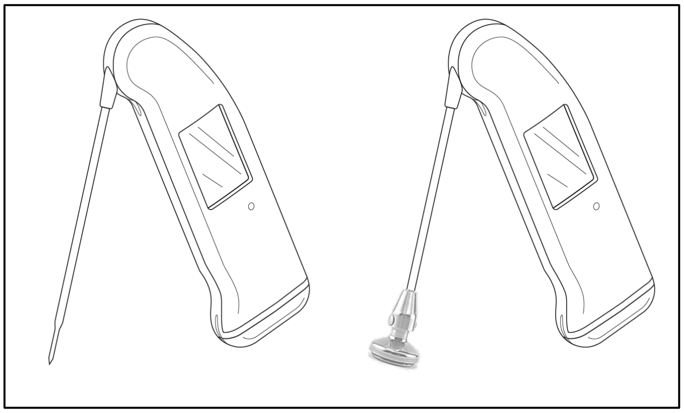

Figure 2.9: Hand-Held Immersion and Surface Temperature Probes

2.7 Personnel

During the fluid testing and exploratory research testing, three APS staff members were required to conduct the tests, and five to six 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 2021-22, five new fluids were received: ClearWing ECO, ChemR Nordik IV, Polar Guard® Xtend, Defrost NORTH 4, and FCY-EGIV. An additional three fluids were received for EG expansion and general testing: ClearWing EG, EG106, and Polar Guard Advance. 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 2021-22 Testing

					2017-18			2018-19			2019-20			2020-21			2021-22		
Sample Name	Dilution	Batch #	Year Received	Receiving 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)	Measured Viscosity (cP)	Falling Ball Temp. (°C)	Falling Ball Time (mm:ss)
AllClear AeroClear MAX	100/0	TAB17-1023	17-18	400	16,500	19.0	0:02				15,500			13,700					
Clariant MaxFlight AVIA	100/0	41	17-18	400	1,838	19.6	0:08	1,980	19.2	0:09	1,926			1,794			1,810	20.8	0:08
Clariant MaxFlight SNEG	100/0	8	17-18	400	18,700	19.6	0:39	19,100	19.5	0:41	19,700			19,900			26,200	20.9	0:40
Clariant Safewing EG IV NORTH	100/0	01819	18-19	400				1,028	19.2	0:05	956	19.5	0:06	1,042			974	20.9	0:05
JSC RCP Nordix (Oksayd) Defrost ECO 4	100/0	#4 (Lot #48)	18-19	300				13,300	19.9	0:34	12,300			10,400			9,100	20.7	0:22
Cryotech Polar Guard Advance	100/0	PGA181205PA	18-19	300							14,820			14,760			15,200	21.0	0:20
DOW EG106	100/0	D268KAG000	20-21	300										42,980	20.0	1:21	40,300	21.0	1:16
AllClear Clearwing EG	100/0	TAB20-CW1207	20-21	400										41,620	20.1	0:09	44,400	20.9	0:08
AllClear ClearWing ECO	100/0	ClearW.WT.21.22	21-22	400													44,680	20.8	2:18
CHEMCO ChemR Nordik IV	100/0	271021-1	21-22	500													63,600	20.9	0:48
JSC RCP Nordix Defrost North 4	100/0	2	21-22	500													3,920	21.0	0:06
Newave FCY-EGIV	100/0	211110001	21-22	300													49,800	20.2	0:06
Cryotech Polar Guard Xtend	100/0	PGX211202PA	21-22	415													14,120	20.7	0:18
AllClear ClearWing EG	100/0	ClearEG.WT.21.22	21-22	400													46,580	20.6	0:08
Dow EG106	100/0	EG.WT.21.22	21-22	500													43,000	20.8	0:51
Cryotech Polar Guard Advance	100/0	PGA211202PA	21-22	415													13,860	20.9	0:18

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 possible with the Stony Brook PDVdi-120 Falling Ball Viscometer (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 with 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 Rotation Lift Loss

To pass, the 8° rotation 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, communicative, 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

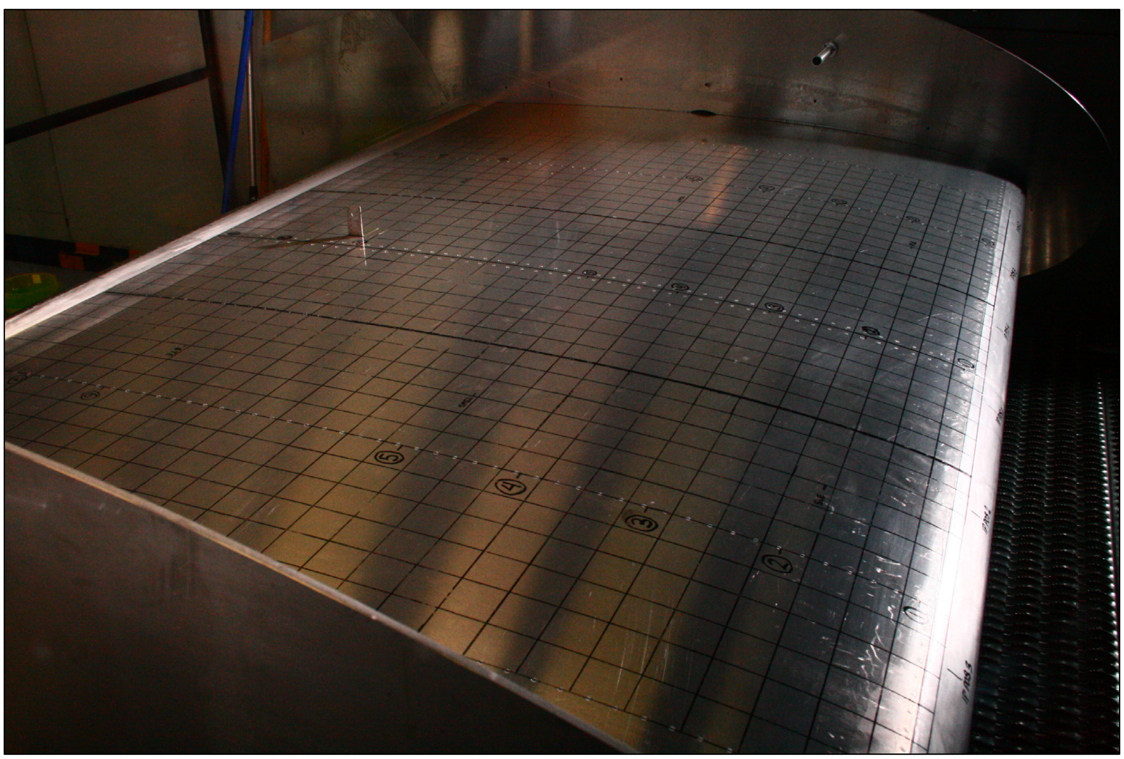

Photo 2.5: Refrigerated Truck Used for Manufacturing Ice Pellets

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

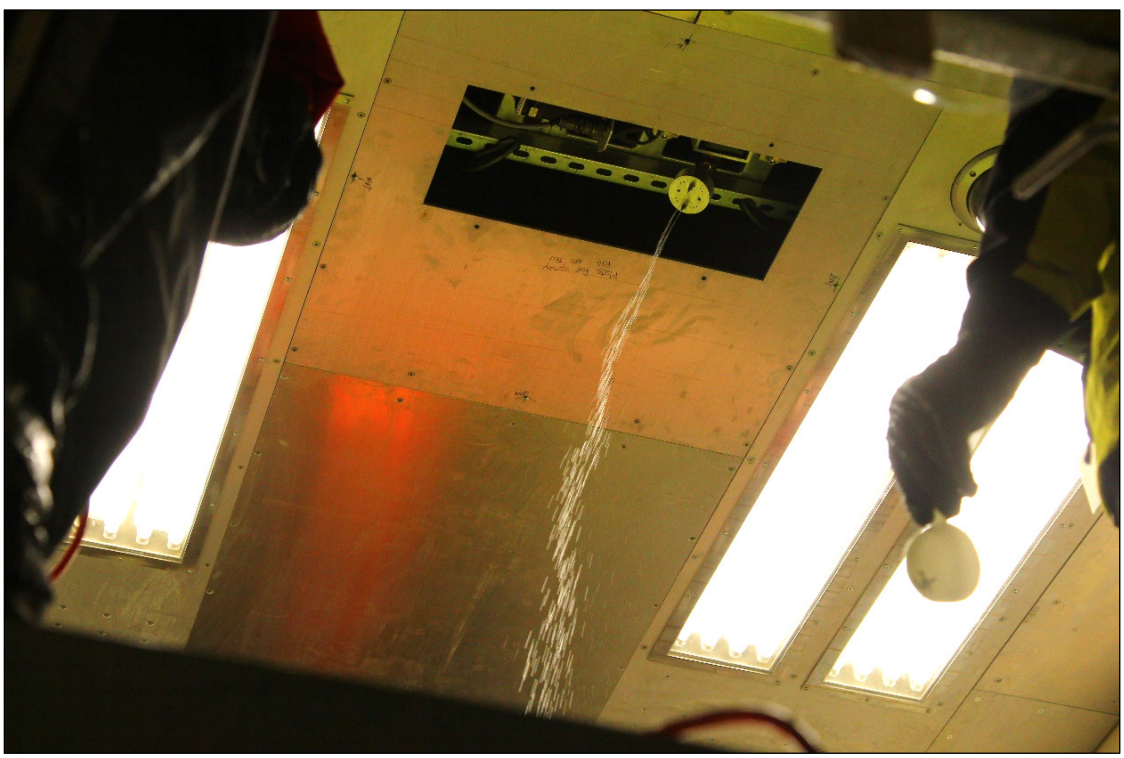

Photo 2.9: Wind Tunnel Setup for Flashes

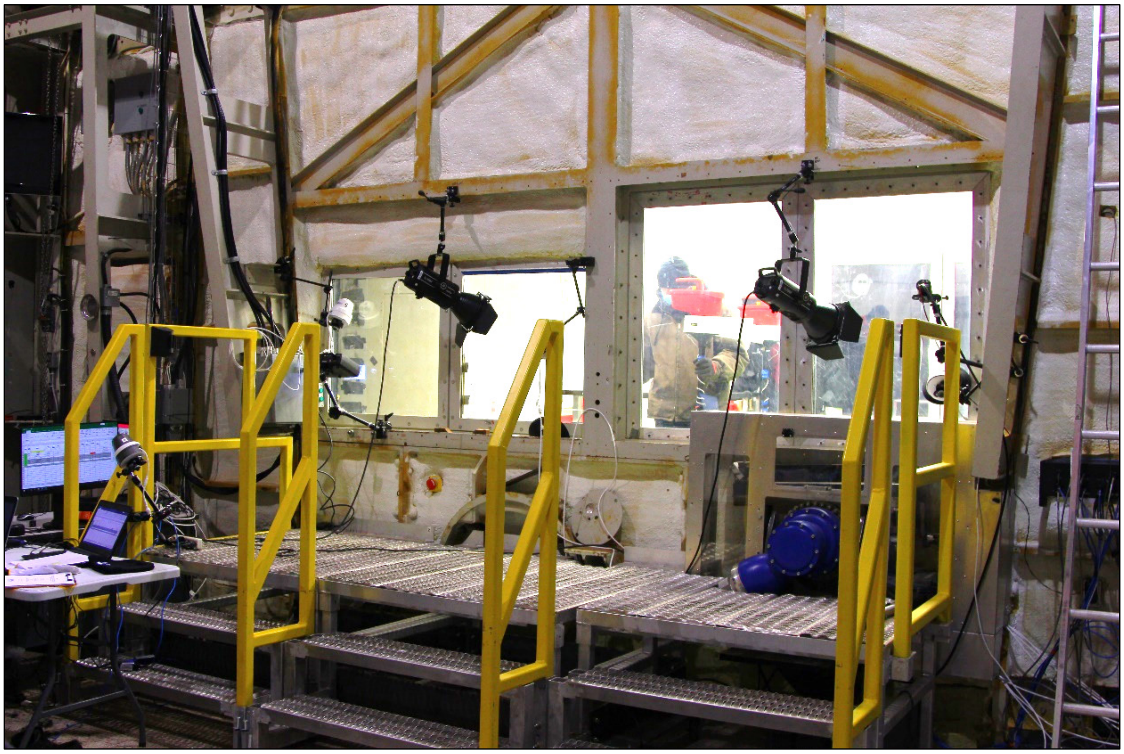

Photo 2.10: Wind Tunnel Setup for Digital Cameras

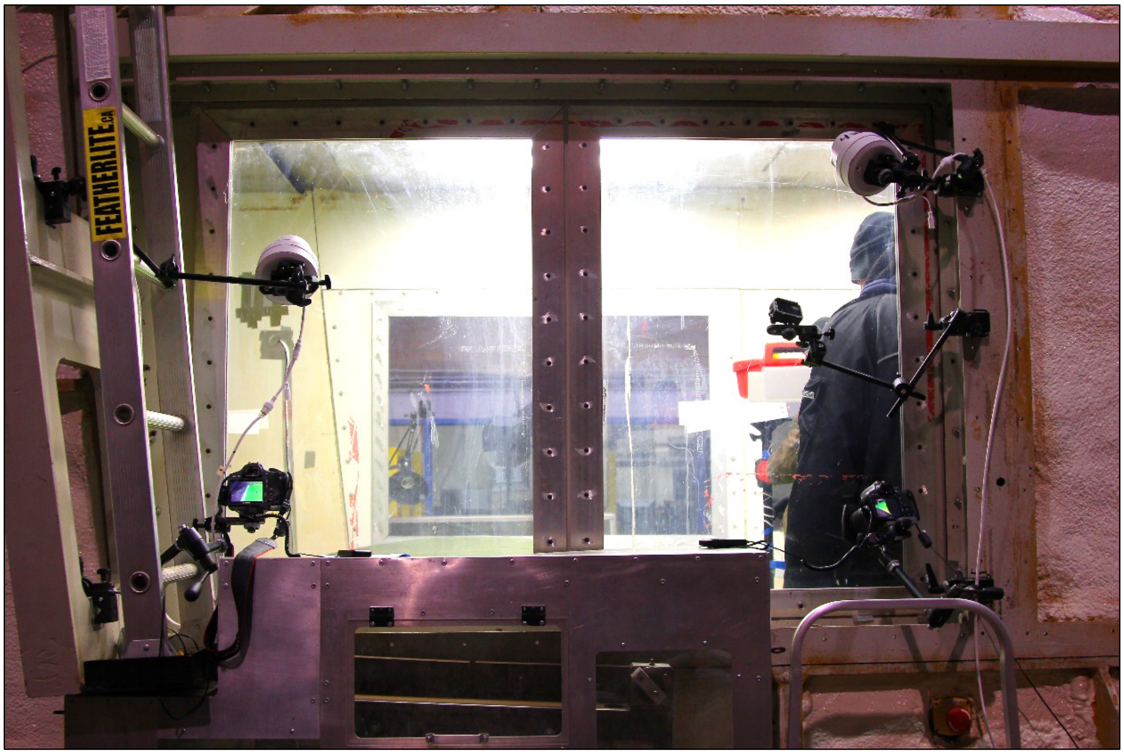

Photo 2.11: Fluid Pour Containers

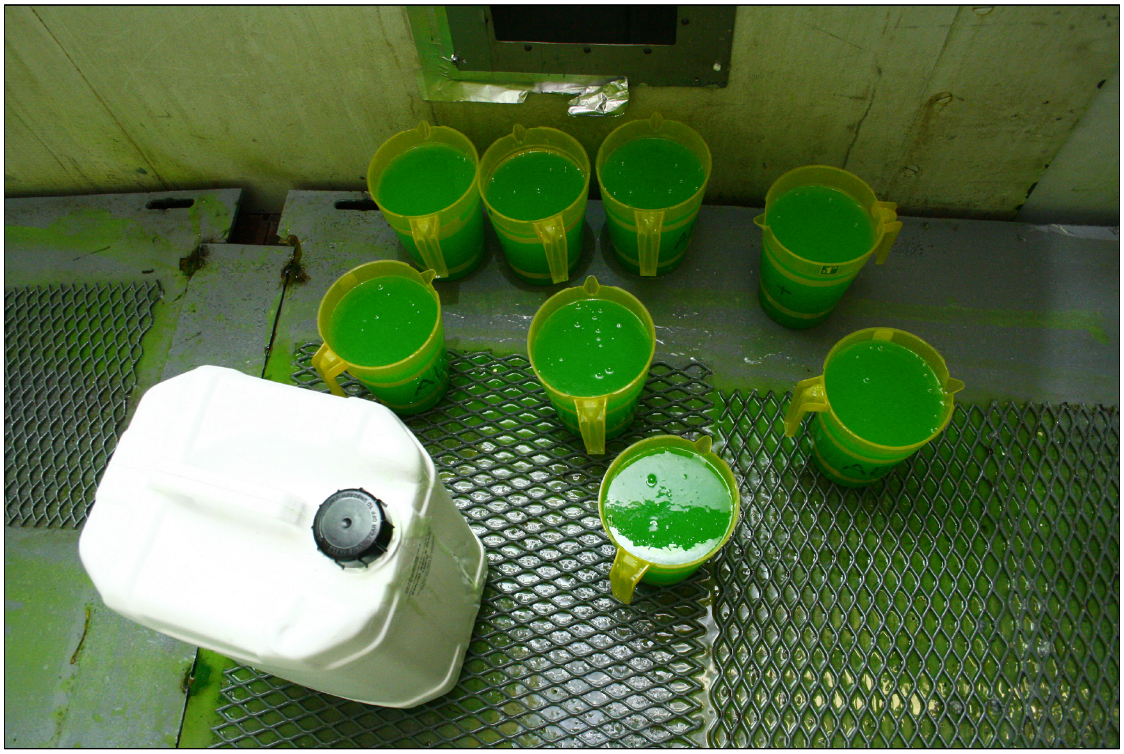

Photo 2.12: 2021-22 Research Team

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 2021-22 can be found in Table 2.1. A detailed log of the tests conducted in the NRC IWT during the winter of 2021-22 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 8º rotation angle and increased to 20º as testing progressed.
Speed (kts):	Maximum speed obtained during simulated takeoff run, recorded in knots.
Flap Angle (0º, 20º):	Positioning of the flap during the precipitation period; either 0º (retracted) or 20º (extended). *Note: Flap was always extended at 20º 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 8º lift coefficient during the test run versus the 8º 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/dm²/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 based on data collected using commercially available Type IV fluids. The Type IV fluid Ice Pellet Allowance Times guidance is generic; therefore, the allowance times must be conservative enough to be applicable to all Type IV fluids on the market.

As new fluids are developed and become commercially available, it is important to evaluate these fluids against the current allowance times to ensure the continued validity of the generic guidance. Due to the open-circuit nature of the wind tunnel test facility, it is not generally feasible to test in all of the conditions listed in the allowance time table in a given year. Therefore, systematic “spot checking” is used to identify any potential issues. Additionally, efforts are made to obtain data with all available fluids close to their 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 2021-22 with the following Type IV EG and PG fluids:

1. AllClear Systems LLC ClearWing ECO;
2. CHEMCO Inc. ChemR Nordik IV;
3. Cryotech Deicing Technology Polar Guard® Xtend;
4. JSC RCP Nordix Defrost NORTH 4; and
5. Newave Aerochemical Co. Ltd. FCY-EGIV.

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:
    - ClearWing ECO – WE;
    - ChemR Nordik IV – RN;
    - Polar Guard® Xtend – XT;
    - Defrost NORTH 4 – DN; and
    - FCY-EGIV – FC.
  - 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. 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 ECO Testing Results

Nine allowance time tests were conducted in 2021-22 with ClearWing ECO. Table 4.1 provides a summary of the tests conducted. The data collected with ClearWing ECO demonstrated higher-than-usual lift losses, which were not typical of the aerodynamic performance expected for a PG Type IV fluid. The points highlighted in red (failed tests) are of particular concern. Of the five failed tests, all of them also had some residual fluid and contamination at the time of rotation that was visually observed.

Due to the five failed wind tunnel test results, an additional exercise was conducted by TC/FAA to evaluate the boundary layer displacement thickness (BLDT) performance of the fluid sample to get a better understanding of the source of the issue. The ClearWing ECO fluid, along with other fluids tested this year, was tested in a "fluid-only" configuration at the IWT, and then the same batch of fluid was submitted for BLDT testing at the same temperature. In the case of the ClearWing ECO fluid, four fluid-only tests were conducted at the IWT; therefore, four BLDT tests were also conducted. The BLDT tests were conducted at -20ºC, -14ºC, -11ºC and -4ºC, and all four of the tests exceeded the BLDT limit, indicating an issue with the fluid batch submitted.

TC and the FAA have since reached out to the manufacturer to investigate this issue further and to determine the actions moving forward; this is ongoing at the time of writing this report. Based on the results obtained, the validation testing for ClearWing ECO is considered incomplete. Further discussions with the fluid manufacturer related to the batch submitted, and likely additional testing with a new batch, will be required before any changes to the guidelines are considered.

Table 4.1: ClearWing ECO Allowance Time Tests

Precipitation Types or Combinations	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 WE-5(7.2)50[4]22R	30 minutes WE-9(11.4)30[108]22B	30 minutes WE-12(9.3)30[50]22B	30 minutes WE-20(11.9)20[20]22B
Light Ice Pellets Mixed with Light Snow	40 minutes WE-5(9)40[43]22R	15 minutes	15 minutes WE-11(9.2)15[67]22B	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	25 minutes	10 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	25 minutes WE-5(8.1)25[56]22B	10 minutes	**Caution:** **No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Rain	25 minutes			
Moderate Ice Pellets (or Small Hail)	15 minutes WE-5(8.9)15[3]22R	10 minutes	10 minutes WE-13(9.4)10[26]22B	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	10 minutes	7 minutes	**Caution:** **No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	10 minutes			

4.3 Cryotech Polar Guard Xtend Testing Results

An initial batch of Cryotech Polar Guard Xtend was submitted for testing in 2020-21. However, based on some data that was collected at or outside the temperature limits with higher recorded lift losses, it was recommended to retest a new batch of fluid to ensure it could be validated for use with the allowance times.

A total of 15 allowance time tests were conducted with Cryotech Polar Guard Xtend in the winter of 2021-22 with a new batch of fluid. Table 4.2 provides a summary of the tests conducted. Of the tests, two were acceptable from visual and aerodynamic perspectives; however, nine tests (#8, #12, #19, #28, #51, #68, #73, #74, and #104) had “Review” status, and four tests (#13, #58, #107, and #126) had “Bad” status.

Upon further investigation of the “Review” tests, Tests #8, #12, #28, #74, and #104 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 #19, #51, #68, and #73 had visual contamination on the leading edge at the time of rotation, which was slightly higher than 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 #58 and #126 failed due to the visual rating, which identified adherence on the flap at the start of the test run after the fluid and contamination had been applied with the flap extended (in the takeoff position). Note that Test #58 was attempting to simulate an above -5 ºC test where the allowance time is 25-minutes, however the actual temperature during the test was colder and hence the associated allowance time for that temperature was 10-minutes. The tests were not re-run as it is known that the visual rating would improve with the flap retracted during the contamination period and because the lift loss was acceptable despite the contamination on the flap.

Test #107 also failed; however, the temperature at the start of the test cooled to -12ºC, two degrees colder than the target -10ºC for a 100-knot test. This had a negative impact on the resulting lift loss. Had the test been repeated with the appropriate 115-knot speed, it is expected that the lift losses would have been within an acceptable range.

Test #13 failed in Light Ice Pellets below -16ºC to -22ºC with a 30-minute exposure time, a cell that has historically shown higher lift losses for PG fluids. As a corrective action, the test was re-run with a shorter exposure time of 20 minutes (Test #19) and the results were acceptable. As a result of this test and with support from historical data (see Figure 4.1), a guidance change was recommended to reduce the PG fluid 30-minute allowance time to 20 minutes for Light Ice Pellets below -16ºC to -22ºC.

Based on these results, the allowance times were validated for Cryotech Polar Guard Xtend.

Table 4.2: Cryotech Polar Guard Xtend Allowance Time Tests

Precipitation Types or Combinations	**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-3(3.8)50[32]22G	30 minutes XT-9(7.1)30[104]22R	30 minutes XT-14(6.5)30[28]22R	30 minutes XT-17(9.4)30[13]22B XT-20(8.3)20[19]22R
Light Ice Pellets Mixed with Light Snow	40 minutes XT-5(5.9)40[73]22R	15 minutes XT-8(7.6)15[8]22R XT-9(7.9)15[51]22R	15 minutes XT-12(6.3)15[68]22R	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	25 minutes	10 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	25 minutes XT-3(3.1)25[126]22B	10 minutes XT-7(6.8)25[58]22B	**Caution:** **No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Rain	25 minutes			
Moderate Ice Pellets (or Small Hail)	15 minutes XT-3(4.2)15[38]22G	10 minutes	10 minutes XT-16(8.9)10[12]22R XT-12(9.3)10[107]22B (100kts)	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	10 minutes	7 minutes XT-10(5.9)7[74]22R	**Caution:** **No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	10 minutes			

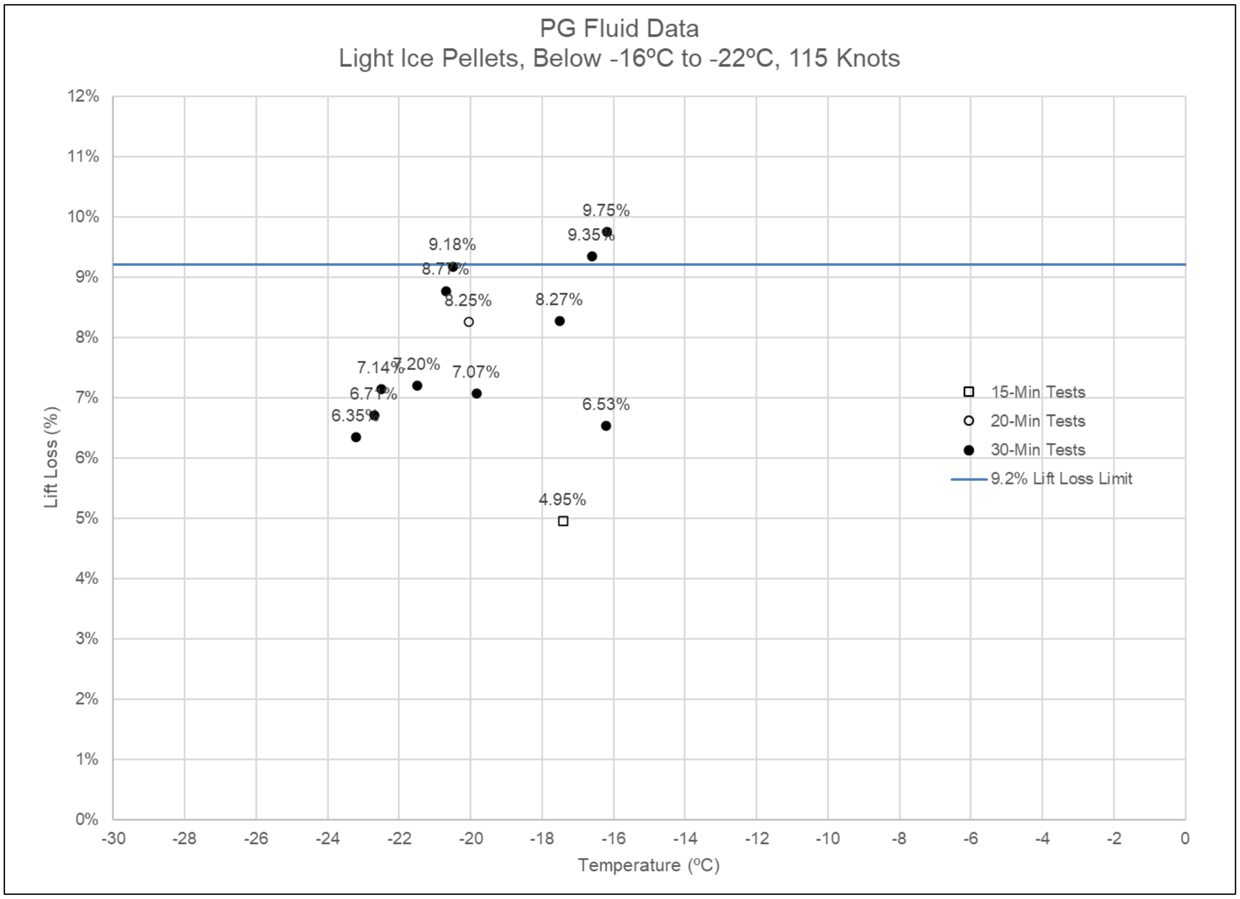

Figure 4.1: Historical PG Data for Light Pellets Below -16ºC to -22ºC

4.4 Defrost North 4 Testing Results

A total of 13 allowance time tests were conducted with Defrost North 4 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 4.3 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 visual and aerodynamic perspectives with the exception of Test #127, run in Light Ice Pellets Mixed with Freezing Rain. The test failed due to the visual rating, which identified adherence on the flap at the start of the test after the EG fluid and contamination had been applied with the flap extended (in the takeoff position). Test #127 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 4.4 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). Test #23 had “Review” status due to visual ratings on the leading edge prior to the start of the test; however, the fluid and contamination were removed at the time of rotation. The low lift losses recorded indicated that these tests could be considered acceptable. Test #55, run in Light Ice Pellets Mixed with Freezing Rain, had “Bad” status due to the visual rating, which identified adherence on the flap at the start of the test after the EG fluid and contamination had been applied with the flap extended (in the takeoff position). Test #55 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 4.5 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 deployed flap 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 Defrost North 4, and the results indicate a good potential to increase the allowance times for EG fluids.

Table 4.3: Defrost North 4 Allowance Time Validation Tests

Precipitation Types or Combinations	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	70 minutes	50 minutes	30 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes DN-3(1.0)50[41]22G	30 minutes DN-11(3.8)30[65]22G	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	Caution: No allowance times currently exist.	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes DN-4(7.6)40[127]22B	30 minutes		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes DN-4(1.2)35[40]22G	25 minutes DN-8(1.9)25[6]22G	10 minutes	10 minutes DN-17(5.3)10[121]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes	Caution: No allowance times currently exist.	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.4: Defrost North 4 Allowance Time Expansion Tests

Precipitation Types or Combinations	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	70 minutes DN-3(0.9)90[34]22G	50 minutes DN-9(2.1)70[102]22G	30 minutes DN-14(2.9)70[48]22G	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes	30 minutes	15 minutes DN-12(4.4)30[88]22G	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes DN-7(4.5)40[55]22B		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes	10 minutes DN-16(4.9)25[23]22R	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes DN-10(3.7)20[76]22G	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.5: All Defrost North 4 Allowance Time Tests

Precipitation Types or Combinations	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	70 minutes DN-3(0.9)90[34]22G	50 minutes DN-9(2.1)70[102]22G	30 minutes DN-14(2.9)70[48]22G	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes DN-3(1.0)50[41]22G	30 minutes DN-11(3.8)30[65]22G	15 minutes DN-12(4.4)30[88]22G	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	Caution: No allowance times currently exist.	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes DN-4(7.6)40[127]22B	30 minutes DN-7(4.5)40[55]22B		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes DN-4(1.2)35[40]22G	25 minutes DN-8(1.9)25[6]22G	10 minutes DN-16(4.9)25[23]22R	10 minutes DN-17(5.3)10[121]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes DN-10(3.7)20[76]22G	Caution: No allowance times currently exist.	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

4.5 ChemR Nordik IV Testing Results

A total of 14 allowance time tests were conducted with ChemR Nordik IV 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 4.6 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 visual and aerodynamic perspectives.

Table 4.7 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 #11, #85, #118, and #119 had “Review” status due to visual ratings on the leading edge prior to the start of the test; however, the fluid and contamination were removed at the time of rotation. The low lift losses recorded indicated that these tests could be considered acceptable. Test #54, run in Light Ice Pellets Mixed with Light Freezing Rain, had “Bad” status due to the visual rating, which identified adherence on the flap at the start of the test after the EG fluid and contamination had been applied with the flap extended (in the takeoff position). Test #54 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 4.8 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 deployed flap 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 ChemR Nordik IV, and the results indicate a good potential to increase the allowance times for EG fluids.

Table 4.6: ChemR Nordik IV Allowance Time Validation Tests

Precipitation Types or Combinations	**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	70 minutes RN-4(1.2)70[33]22G	50 minutes	30 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes RN-4(0.6)50[72]22G	30 minutes RN-10(2.1)30[64]22G	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes	10 minutes	10 minutes RN-18(3.3)10[120]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes RN-11(1.4)10[75]22G	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.7: ChemR Nordik IV Allowance Time Expansion Tests

Precipitation Types or Combinations	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	70 minutes	50 minutes RN-11(1.6)70[101]22G	30 minutes RN-15(1.6)50[47]22G	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes	30 minutes	15 minutes RN-13(2.5)30[80]22G	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes RN-6(4.0)40[54]22B		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes RN-8(1.2)35[5]22G	10 minutes RN-16(3.1)25[11]22R RN-16(2.5)20[118]22R RN-16(2.8)15[119]22R	10 minutes RN-17(2.9)20[85]22R
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.8: All ChemR Nordik IV Allowance Time Tests

Precipitation Types or Combinations	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	70 minutes RN-4(1.2)70[33]22G	50 minutes RN-11(1.6)70[101]22G	30 minutes RN-15(1.6)50[47]22G	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes RN-4(0.6)50[72]22G	30 minutes RN-10(2.1)30[64]22G	15 minutes RN-13(2.5)30[80]22G	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	Caution: No allowance times currently exist.	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes RN-6(4.0)40[54]22B		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes RN-8(1.2)35[5]22G	10 minutes RN-16(3.1)25[11]22R RN-16(2.5)20[118]22R RN-16(2.8)15[119]22R	10 minutes RN-17(2.9)20[85]22R RN-18(3.3)10[120]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes RN-11(1.4)10[75]22G	Caution: No allowance times currently exist.	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

4.6 FCY-EGIV Testing Results

A total of 11 allowance time tests were conducted with FCY-EGIV 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 4.9 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 visual and aerodynamic perspectives with the exception of Test #66, run in Light Ice Pellets Mixed with Light Snow. Tests #66 had "Review" status due to visual ratings on the leading edge prior to the start of the test; however, the fluid and contamination was removed at the time of rotation. The low lift losses recorded indicated that these tests could be considered acceptable.

Table 4.10 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

#24, #39, and #90 had "Review" status due to visual ratings on the leading edge prior to the start of the test; however, the fluid and contamination were removed at the time of rotation. The low lift losses recorded indicated that these tests could be considered acceptable. Test #57, run in Light Ice Pellets Mixed with Light Freezing Rain, had "Bad" status 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 #57 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 4.11 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 deployed flap 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 FCY-EGIV, and the results indicate a good potential to increase the allowance times for EG fluids.

Table 4.9: FCY-EGIV Allowance Time Validation Tests

Precipitation Types or Combinations	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	70 minutes	50 minutes	30 minutes	30 minutes FC-15(3.1)30[123]22G
Light Ice Pellets Mixed with Light Snow	50 minutes	30 minutes FC-11(3.1)30[66]22R	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes FC-9(1.8)25[7]22G	10 minutes	10 minutes FC-16(2.5)10[122]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.10: FCY-EGIV Allowance Time Expansion Tests

Precipitation Types or Combinations	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	70 minutes FC-4(1.5)90[35]22G	50 minutes FC-9(0.8)70[103]22G	30 minutes FC-13(2.5)60[49]22G	30 minutes
Light Ice Pellets Mixed with Light Snow	50 minutes	30 minutes	15 minutes FC-13(4.5)30[90]22R	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes FC-6(4.7)40[57]22B		
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes FC-3(1.2)45[39]22R	25 minutes	10 minutes FC-15(4.7)25[24]22R	10 minutes
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

Table 4.11: All FCY-EGIV Allowance Time Tests

Precipitation Types or Combinations	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	70 minutes FC-4(1.5)90[35]22G	50 minutes FC-9(0.8)70[103]22G	30 minutes FC-13(2.5)60[49]22G	30 minutes FC-15(3.1)30[123]22G
Light Ice Pellets Mixed with Light Snow	50 minutes	30 minutes FC-11(3.1)30[66]22R	15 minutes FC-13(4.5)30[90]22R	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	40 minutes	30 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	40 minutes	30 minutes FC-6(4.7)40[57]22B	**Caution:** **No allowance times currently exist.**	
Light Ice Pellets Mixed with Light Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes FC-3(1.2)45[39]22R	25 minutes FC-9(1.8)25[7]22G	10 minutes FC-15(4.7)25[24]22R	10 minutes FC-16(2.5)10[122]22G
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Freezing Drizzle	20 minutes	10 minutes	**Caution:** **No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Moderate Rain	15 minutes			

5. 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 expansion testing with EG fluids was performed.

Initial data collected led to the development of a separate EG allowance time table that was published for the winter of 2021-22. However, the expanded times primarily focused on temperatures above -10ºC, which is where the bulk of the data was collected. Additional testing was recommended focusing on temperatures below -10ºC.

5.1 Analysis of EG Fluid Allowance Times

An analysis was conducted based on the EG fluids tested during the winter of 2021-22, as well as on historical testing that occurred between 2009 and 2021. The data includes 181 tests, which comprised allowance time development, validation, and expansion tests. Of the 181 data points, 46 were collected in 2021-22. The analysis included 10 EG fluids:

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

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). Note that the tests in Table 5.3 include only those that were run longer than the current allowance time or in conditions where there are no allowance times.

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;
    - Chemco ChemR Nordik IV – RN;
    - Clariant Avia – CA;
    - Clariant North – CN;
    - Dow EG106 – DE;
    - LNT E450 – LE;
    - Defrost EG IV – FR;
    - Defrost North 4 – DN; and
    - Newave FCY-EGIV – FC.
  - 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	70 minutes CW0(1.4)50[10]21G DE-4(0.9)50[22]10G CW-4(2.6)70[99]21G RN-4(1.2)70[33]22G 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 DN-3(0.9)90[34]22G FC-4(1.5)90[35]22G	50 minutes RN-10(2.1)30[64]22G 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 DN-9(2.1)70[102]22G FC-9(0.8)70[103]22G RN-11(1.6)70[101]22G	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 FC-15(3.1)30[123]22G RN-15(1.6)50[47]22G CN-16(2.8)50[7]20G DE-16(0.8)50[77]22G CW-16(3.6)50[83]22R FC-13(2.5)60[49]22G DN-14(2.9)70[48]22G	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 CA-18(3.1)50[84]22G
Light Ice Pellets Mixed with Snow	50 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 DN-3(1.0)50[41]22G DE-4(3.2)50[71]21G RN-4(0.6)50[72]22G CC-5(3.7)50[33]18R CN-5(1.5)50[20]20G	30 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 DN-11(3.8)30[65]22G FC-11(3.1)30[66]22R	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 DN-11(3.8)30[65]22G DN-12(4.4)30[88]22G RN-13(2.5)30[80]22G FC-13(4.5)30[90]22R DE-14(2.7)25[78]11G CC-14(3.2)30[12]20G DE-14(1.9)30[14]20G CN-14(4.0)30[89]22G FR-15(3.4)30[16]20G CW-16(7.2)30[81]22R	0 minutes DE-17(2.0)15[310]14G DE-18(4.1)15[311]14R
Light Ice Pellets Mixed with Freezing Drizzle	40 minutes CN-2(6.9)40[90]21R FR-2(3.9)40[91]21R CW-2(7.8)40[92]21B	30 minutes CC-6(5.4)30[32]18R CW-9(6.7)30[80]21B CA-10(5.6)30[79]21B		
Light Ice Pellets Mixed with Freezing Rain	40 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*- CC-2(12.8)35[75]21B CW-2(6.5)40[73]21B CC-2(9.9)40[74]21B CC-3(2.3)40[76]21R- DN-4(7.6)40[127]22B CN-5(4.7)40[22]20B	30 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 CN-10(5.1)30[65]21B CC-11(7.5)30[67]21B RN-6(4.0)40[54]22B FC-6(4.7)40[57]22B DN-7(4.5)40[55]22B 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 DE-10(7.2)40[126]11B	0 minutes CA-11(7.0)30[66]21B CC-12(5.8)30[43]18B	**Caution: No allowance times currently exist.**

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
Light Ice Pellets Mixed with Rain	40 minutes FR1(1.4)25[36]19G LE0(4.3)25[76]16G CW0(3.1)25[23]21B*	**Caution: No allowance times currently exist.**		
Moderate Ice Pellets (or Small Hail)	35 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 DN-4(1.2)35[40]22G 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 FC-3(1.2)45[39]22R	25 minutes CC-10(1.9)10[13]18G DE-8(2.2)25[50]21G DN-8(1.9)25[6]22G CA-9(3.3)25[51]21G FC-9(1.8)25[7]22G CC-10(2.3)25[42]18G RN-8(1.2)35[5]22G	10 minutes CN-13(2.4)10[3]20G LE-15(6.4)10[13]16R CC-15(2.7)10[18]18G FC-16(2.5)10[122]22G RN-16(2.8)15[119]22R CA-16(4.1)20[91]22R RN-16(2.5)20[118]22R CC-14(2.1)25[11]20R DE-15(1.1)25[13]20R FC-15(4.7)25[24]22R CN-16(2.2)25[6]20R FR-16(2.8)25[15]20G RN-16(3.1)25[11]22R DN-16(4.9)25[23]22R	10 minutes LE-17(6.0)10[11]16R DN-17(5.3)10[121]22G DE-18(1.8)10[71]10G RN-18(3.3)10[120]22G DE-21(3.1)10[26]11G CA-21(5.5)10[16]19R FR-21(6.6)10[18]19R RN-17(2.9)20[85]22R CW-17(3.8)25[82]22B
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	20 minutes CC-3(7.3)20[100]21R CW-3(7.1)20[88]21B CA-4(3.6)20[86]21G CN-5(0.8)20[23]20G FR-7(3.6)20[105]21R DE-4(7.4)25[87]21B	10 minutes CC-8(2.4)7[9]18G DE-10(2.6)10[81]21G RN-11(1.4)10[75]22G CN-9(4.0)15[82]21G CA-9(3.4)15[83]21G DN-10(3.7)20[76]22G	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	15 minutes CC-3(7.2)10[39]18B DE-1(2.1)12[21]21R*- CC2(2.3)15[26]21G* DE2(1.9)15[31]21G DE1(1.9)15[27]21G* FR1(2.3)15[35]21R 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*- CN-1(6.7)15[22]21B* CW-1(7.1)15[14]21B* DE2(1.9)20[30]21G CW2(1.0)20[32]21G FR1(2.3)20[33]21B FR1(1.6)20[34]21B- CW0(13.0)20[13]21B*			

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

Table 5.2: EG Validation Tests (Meeting 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	70 minutes CW0(1.4)50[10]21G DE-4(0.9)50[22]10G CW-4(2.6)70[99]21G RN-4(1.2)70[33]22G 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	50 minutes RN-10(2.1)30[64]22G 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 FC-15(3.1)30[123]22G	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	50 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 DN-3(1.0)50[41]22G DE-4(3.2)50[71]21G RN-4(0.6)50[72]22G CC-5(3.7)50[33]18R CN-5(1.5)50[20]20G	30 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 DN-11(3.8)30[65]22G FC-11(3.1)30[66]22R	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	40 minutes CN-2(6.9)40[90]21R FR-2(3.9)40[91]21R CW-2(7.8)40[92]21B	30 minutes CC-6(5.4)30[32]18R CW-9(6.7)30[80]21B CA-10(5.6)30[79]21B		
Light Ice Pellets Mixed with Freezing Rain	40 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*- CC-2(12.8)35[75]21B CW-2(6.5)40[73]21B CC-2(9.9)40[74]21B CC-3(2.3)40[76]21R- DN-4(7.6)40[127]22B CN-5(4.7)40[22]20B	30 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 CN-10(5.1)30[65]21B CC-11(7.5)30[67]21B	0 minutes	**Caution: No allowance times currently exist.**
Light Ice Pellets Mixed with Rain	40 minutes FR1(1.4)25[36]19G LE0(4.3)25[76]16G CW0(3.1)25[23]21B*			

Table 5.2: EG Validation Tests (Meeting 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)	35 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 DN-4(1.2)35[40]22G 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	25 minutes CC-10(1.9)10[13]18G DE-8(2.2)25[50]21G DN-8(1.9)25[6]22G CA-9(3.3)25[51]21G FC-9(1.8)25[7]22G 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 FC-16(2.5)10[122]22G	10 minutes LE-17(6.0)10[11]16R DN-17(5.3)10[121]22G DE-18(1.8)10[71]10G RN-18(3.3)10[120]22G DE-21(3.1)10[26]11G CA-21(5.5)10[16]19R FR-21(6.6)10[18]19R
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	20 minutes CC-3(7.3)20[100]21R CW-3(7.1)20[88]21B CA-4(3.6)20[86]21G CN-5(0.8)20[23]20G FR-7(3.6)20[105]21R	10 minutes CC-8(2.4)7[9]18G DE-10(2.6)10[81]21G RN-11(1.4)10[75]22G	**Caution:** **No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	15 minutes CC-3(7.2)10[39]18B DE-1(2.1)12[21]21R*- CC2(2.3)15[26]21G* DE2(1.9)15[31]21G DE1(1.9)15[27]21G* FR1(2.3)15[35]21R 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*- 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 5.3: EG Expansion Tests (Exceeding 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	70 minutes DN-3(0.9)90[34]22G FC-4(1.5)90[35]22G	50 minutes DN-9(2.1)70[102]22G FC-9(0.8)70[103]22G RN-11(1.6)70[101]22G	30 minutes RN-15(1.6)50[47]22G CN-16(2.8)50[7]20G DE-16(0.8)50[77]22G CW-16(3.6)50[83]22R FC-13(2.5)60[49]22G DN-14(2.9)70[48]22G	30 minutes CA-18(3.1)50[84]22G
Light Ice Pellets Mixed with Snow	50 minutes	30 minutes	15 minutes DN-11(3.8)30[65]22G DN-12(4.4)30[88]22G RN-13(2.5)30[80]22G FC-13(4.5)30[90]22R DE-14(2.7)25[78]11G CC-14(3.2)30[12]20G DE-14(1.9)30[14]20G CN-14(4.0)30[89]22G FR-15(3.4)30[16]20G CW-16(7.2)30[81]22R	0 minutes
Light Ice Pellets Mixed with Freezing Drizzle	40 minutes	30 minutes		
Light Ice Pellets Mixed with Freezing Rain	40 minutes	30 minutes RN-6(4.0)40[54]22B FC-6(4.7)40[57]22B DN-7(4.5)40[55]22B 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 DE-10(7.2)40[126]11B	0 minutes	**Caution: No allowance times currently exist.**
Light Ice Pellets Mixed with Rain	40 minutes			

Table 5.3: EG Expansion Tests (Exceeding 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)	35 minutes FC-3(1.2)45[39]22R	25 minutes RN-8(1.2)35[5]22G	10 minutes RN-16(2.8)15[119]22R CA-16(4.1)20[91]22R RN-16(2.5)20[118]22R CC-14(2.1)25[11]20R DE-15(1.1)25[13]20R FC-15(4.7)25[24]22R CN-16(2.2)25[6]20R FR-16(2.8)25[15]20G RN-16(3.1)25[11]22R DN-16(4.9)25[23]22R	10 minutes RN-17(2.9)20[85]22R CW-17(3.8)25[82]22B
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	20 minutes DE-4(7.4)25[87]21B	10 minutes CN-9(4.0)15[82]21G CA-9(3.4)15[83]21G DN-10(3.7)20[76]22G	**Caution:** **No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	15 minutes DE2(1.9)20[30]21G CW2(1.0)20[32]21G FR1(2.3)20[33]21B FR1(1.6)20[34]21B- CW0(13.0)20[13]21B*			

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

5.2 Proposed Changes for an EG Specific Allowance Time Table

Based on the results, each cell of the EG allowance time table was analysed for 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 (or historical 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	70 minutes	50 minutes	~~30 minutes~~ 50 minutes	30 minutes Limited Data
Light Ice Pellets Mixed with Snow	50 minutes	30 minutes	~~15 minutes~~ 25 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	40 minutes	30 minutes	**Caution: No allowance times currently exist.**	
Light Ice Pellets Mixed with Freezing Rain	40 minutes	30 minutes		
Light Ice Pellets Mixed with Rain	40 minutes			
Moderate Ice Pellets (or Small Hail)	35 minutes	25 minutes	~~10 minutes~~ 15 minutes	10 minutes Limited Data
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	20 minutes	10 minutes	**Caution: No allowance times currently exist.**	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	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	-	-	67%	-
Light Ice Pellets Mixed with Snow	-	-	67%	
Light Ice Pellets Mixed with Freezing Drizzle	-	-	Caution: No allowance times currently exist.	
Light Ice Pellets Mixed with Freezing Rain	-	-		
Light Ice Pellets Mixed with Rain	-			
Moderate Ice Pellets (or Small Hail)	-	-	50%	-
Moderate Ice Pellets (or Small Hail) Mixed with Freezing Drizzle	-	-	Caution: No allowance times currently exist.	
Moderate Ice Pellets (or Small Hail) Mixed with Rain	-			

The data collected to date indicates the potential for longer allowance times specific to EG fluids. The cells recommended are in the below -10ºC to -16ºC range, as much of the supporting testing conducted in 2021-22 was targeting this temperature range. Although some cells below -16ºC contain historical data supporting a potential expansion, there is not enough data to support a thorough analysis at this time.

The following are some general guidelines followed when expanding times for EG fluids:

- Each of the cells contains at least three different EG fluid expansion tests;
- There does not appear to be any worse-performing EG fluid that could be used as the "worst-case fluid";
- 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.

5.2.1 Proposed Changes to the HOT Guidelines

For the Winter 2022-23 HOT Guidelines, TC and the FAA agreed to update the separate Type IV EG fluid allowance time table to incorporate the longer times (as shown in Table 5.4) in the below -10ºC to -16ºC range.

There is a potential to develop longer allowance times for Type IV EG fluids below -16ºC; however, additional data is required to support the preliminary data collected to date.

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6. EVALUATION OF NEW MIXED CONDITIONS

Over the years, the ice pellet allowance times have been expanded to include additional conditions, temperature ranges, and fluid types. The current tables are a reflection of the conditions whereby sufficient data was collected to substantiate the guidance provided to operators. There are still conditions where data is either limited or not available that could be suitable areas for development of new guidance material to expand the operational envelope. In addition, new-generation fluids may have better performance capabilities and may justify an extension to existing times.

More recently, a METAR working group consisting of TC, the FAA, APS, and NCAR has been formed with the objective of improving the guidance available for operations in mixed conditions. Of the conditions being analysed, some are combinations including ice pellets and can sometimes contain two, three, or more precipitation types at a time. Aerodynamic data could support the development of guidance material for these specific conditions, and, as such, some limited exploratory testing was conducted.

The preliminary testing targeted two conditions based on industry requests. The first was a dual condition: Moderate Ice Pellets and Moderate Snow. Initial exploratory testing had been conducted in this condition in 2015-16, and this testing would build upon that. The second was a triple condition: Mixed Light Ice Pellets, Light Freezing Rain, and Light Snow.

6.1 Analysis of Mixed Condition Tests

An analysis was conducted based on the fluids tested during the winter of 2021-22. The data includes 12 tests from 2021-22 and 8 tests from 2015-16, including both EG and PG fluids in two mixed conditions. For Moderate Ice Pellets and Moderate Snow, the precipitation rates of 75 + 25 g/dm²/h, respectively, were used. For Mixed Light Ice Pellets, Light Freezing Rain, and Light Snow, the precipitation rates of 25 + 25 + 10 g/dm²/h, respectively, were used.

The detailed data has been reviewed and a copy has been included in Appendix F for reference (refer to Subsection 3.1 for heading descriptions). For Table 6.1, 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 Nordik IV – RN;
    - Clariant North – CN;
    - Dow AD-49 – AD;
    - Dow EG106 – DE;
    - Defrost North 4 – DN;
    - Kilfrost ABC-S+ – AB;
    - Maxflight Sneg – MS;
    - Defrost Eco 4 – DC; and
    - Polar Guard Advance – PGA.
  - 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 6.1: Mixed Condition Test Summary

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 and Moderate Snow	PG Fluid Tests AB-4(6.7)7[40]16R AB-4(7.5)10[41]16R AD-4(7.3)10[45]16R PGA-5(9.3)10[52]16B	PG Fluid Tests AB-8(7.4)7[23]16R AB-8(7.4)10[24]16R PGA-7(11.1)10[36]16B PGA-8(9.4)7[37]16B	EG Fluid Tests CN-14(4.2)10[111]22G DE-14(3.6)10[116]22G RN-15(4.0)10[113]22R CW-15(8.3)10[93]22R DN-13(5.2)15[110]22R DE-14(4.4)15[92]22R PG Fluid Tests MS-14(8.0)5[109]22R DC-15(8.5)5[112]22R PGA-15(7.6)5[117]22R MS-17(9.5)7[94]22B	
Light Ice Pellets, Light Freezing Rain, and Light Snow	EG Fluid Tests RN-7(3.0)20[129]22B PG Fluid Tests PGA-4(3.3)20[128]22B			

6.2 Summary of Mixed Conditions Data

The data collected was limited but indicated a potential for future development. In the mixed condition of Moderate Ice Pellets and Moderate Snow, the data indicated a potential allowance time target of 5 minutes for PG fluids and 10 to 15 minutes for EG fluids below -10ºC to -16ºC. In the -10ºC and above range, only PG fluids were tested, and the data indicated that less than 7 minutes could be possible. In the mixed condition of Light Ice Pellets, Light Freezing Rain, and Light Snow, the data indicated a potential allowance time target of 20 minutes for EG and PG fluids.

It should be noted that the data contained several "Review" and "Bad" data points, as the process of developing new allowance times requires testing to the limits to determine where the tests fail and then selecting an appropriate target to substantiate with several surrogate fluids. In this case, additional testing with multiple fluids and at different temperatures would be required to develop comprehensive allowance times for these two mixed conditions.

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7. RE-VALIDATION OF LIFT LOSS SCALING ANALYSIS

The lift loss scaling analysis provides the basis for the aerodynamic evaluation criteria used for allowance time testing. The methodology was developed between 2009 and 2011 and is based on the principle of corelating the lift losses recorded at the NRC IWT with the RJ wing to the BLDT data acquired at the Anti-Icing Materials International Laboratory (AMIL), thus linking the lift losses back to the historical aerodynamic acceptance test criteria. Figure 7.1 provides a schematic demonstrating the correlation between the different test and evaluation criteria.

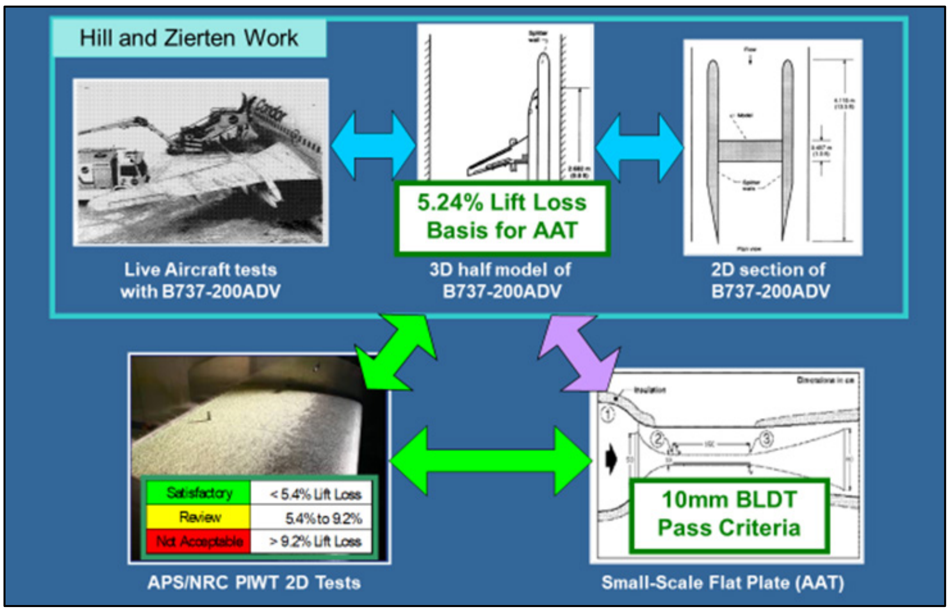

Figure 7.1: Correlation of IWT Test List Data to the Aerodynamic Acceptance Test

During the yearly or bi-yearly allowance time testing, fluid-only tests are conducted with new fluids to determine their performance according to the IWT lift loss limits determined to ensure fluids are behaving as expected. BLDT testing is not typically conducted as part of the allowance time testing. However, this year a re-validation of the lift loss scaling analysis was performed with a new generation of fluids to determine whether the evaluation criteria being used are still acceptable. This required fluid-only tests be conducted at the IWT followed by BLDT testing at the same temperature and with the same batch of fluid. It should be noted that this activity was primarily done for due diligence based on the higher lift losses recorded by the ClearWing ECO to ensure that the issue was isolated to the fluid and not the methodology. Going forward, it would be good practice to conduct a periodical verification every five years.

The 2021-22 re-validation was performed with 18 new data points. Fluid-only tests were conducted at the IWT, and the same sample of fluid was submitted for BLDT testing. Table 7.1 provides an abbreviated summary of the different data sets used for the lift loss correlation. Table 7.2 provides a summary of the updated lift loss correlation with a sensitivity analysis conducted to determine how different data sets would affect the output evaluation criteria.

The ClearWing ECO data points (four fluid-only tests) had high IWT lift losses and high BLDT results that exceeded the acceptable limits for both tests. With this data being outside the "known performance range," the data scatter affected the standard error of estimate. When combining all data points, the scatter increases the criteria range to 5.0–10.1 percent from the currently used 5.4–9.2 percent range. With the ClearWing ECO data removed, the criteria range of 5.1–9.7 percent was more in line with the historical data. The latter analysis was suggested to be most appropriate since the ClearWing ECO fluid performance falls outside the "known performance range."

A separate analysis of EG versus PG fluids also showed some differences in the general behaviour of the different fluid types, but not enough to merit a change in procedures. In the future, a more in-depth review of EG versus PG fluids could be conducted.

As such, the lift loss criteria developed as part of the original correlation analysis (see Table 7.3) remain unchanged and are considered re-validated. A periodic five-year revisit of this analysis is suggested as new-generation fluids come onto the market.

Table 7.1: Abbreviated Log of Lift Loss Correlation Data

Test #	Test Year	Analysis Set	Rotation Angle (°)	Ramp Time 40 kts to Rotation (sec)	Rotation Speed (kts)	EG or PG Fluid	Lift Loss Measured and Corrected (%)	Tunnel Temp (°C)	BLDT Interpolated from Qualification Reports (mm)
76	Winter 2009-10	Original 44 pts	8	16	103	PG	4.88	-17.9	6.8
64	Winter 2009-10	Original 44 pts	8	16	102.5	PG	4.21	-13.4	7.0
96	Winter 2009-10	Original 44 pts	18	20.5	103	PG	5.34	-11.2	7.1
1	Winter 2009-10	Original 44 pts	8	26	100	PG	4.59	-5.7	7.05
17	Winter 2009-10	Original 44 pts	8	17	102	PG	4.96	-3.9	7.0
53	Winter 2009-10	Original 44 pts	8	17	103	PG	3.38	-1.9	7.00
75	Winter 2009-10	Original 44 pts	8	15	104	EG	3.25	-18.1	6.35
94	Winter 2009-10	Original 44 pts	18	21	103	EG	1.90	-7.8	5.2
100	Winter 2009-10	Original 44 pts	8	16	102	EG	2.04	-6.3	5
25	Winter 2009-10	Original 44 pts	8	21	102	EG	2.01	-4	4.7
55	Winter 2009-10	Original 44 pts	8	18	103	EG	1.73	-2.6	4.5
70	Winter 2009-10	Original 44 pts	8	17.2	103	PG	4.11	-17.9	9.4
29	Winter 2009-10	Original 44 pts	8	17.7	102	PG	4.71	-4.8	8.4
60	Winter 2009-10	Original 44 pts	8	20.6	102	PG	4.35	-2.8	8.2
54	Winter 2009-10	Original 44 pts	8	22.7	102	PG	3.30	-2.2	8.25
30	Winter 2010-11	Original 44 pts	8	17	104	PG	8.13	-23.5	8.80
21	Winter 2010-11	Original 44 pts	8	18	104	PG	6.56	-18.2	8.45
80	Winter 2010-11	Original 44 pts	18	19	103	PG	6.96	-15.1	8.35
81	Winter 2010-11	Original 44 pts	8	20	103	PG	7.10	-14.7	8.35
54	Winter 2010-11	Original 44 pts	8	19.5	103	PG	5.78	-12.1	8.20
97	Winter 2010-11	Original 44 pts	18	20	103	PG	5.91	-11.9	8.20
32	Winter 2010-11	Original 44 pts	8	19	104	PG	3.92	-22.5	7.7
42	Winter 2010-11	Original 44 pts	8	18	103	PG	3.57	-15.7	6.2
55	Winter 2010-11	Original 44 pts	8	18	103	PG	2.57	-11.4	5.4
68	Winter 2010-11	Original 44 pts	17	22	103	PG	3.66	-1.8	6.7
34	Winter 2010-11	Original 44 pts	8	17	104	EG	4.28	-23.3	7.0
43	Winter 2010-11	Original 44 pts	8	19	103	EG	3.07	-15	5.9
52	Winter 2010-11	Original 44 pts	8	18	103	EG	2.78	-13.4	5.7
77	Winter 2010-11	Original 44 pts	18	21	103	EG	2.60	-11.8	5.55
95A	Winter 2010-11	Original 44 pts	18	21	103	EG	2.53	-10.4	5.4
29	Winter 2010-11	Original 44 pts	8	17	104	PG	6.56	-23.9	9.65
48	Winter 2010-11	Original 44 pts	14	19	103	PG	4.07	-13.1	8.95
101	Winter 2009-10	Original 44 pts	8	15.7	103	PG	4.79	-7.6	8.5
62	Winter 2010-11	Original 44 pts	8	20	103	PG	5.06	-4.9	8.4
63	Winter 2010-11	Original 44 pts	8	22	103	PG	5.34	-4.5	8.4
60	Winter 2010-11	Original 44 pts	8	20	103	PG	4.71	-4.2	8.4

Table 7.1: Abbreviated Log of Lift Loss Correlation Data (cont'd)

Test #	Test Year	Analysis Set	Rotation Angle (°)	Ramp Time 40 kts to Rotation (sec)	Rotation Speed (kts)	EG or PG Fluid	Lift Loss Measured and Corrected (%)	Tunnel Temp (°C)	BLDT Interpolated from Qualification Reports (mm)
61	Winter 2010-11	Original 44 pts	8	20	103	PG	4.49	-3.5	8.35
33	Winter 2010-11	Original 44 pts	8	17	104	PG	8.27	-24.1	9
39	Winter 2010-11	Original 44 pts	8	18	103	PG	7.20	-16	8.3
12	Winter 2010-11	Original 44 pts	8	21	104	PG	6.05	-14.2	8.25
57	Winter 2010-11	Original 44 pts	8	18	103	PG	6.85	-9.9	8.25
75	Winter 2010-11	Original 44 pts	8	21	103	PG	7.45	-5.8	8.2
76	Winter 2010-11	Original 44 pts	18	N/A	103	PG	6.61	-5.5	8.2
71	Winter 2010-11	Original 44 pts	18	20	103	PG	6.33	-3.7	8.1
139	Winter 2012-13	Re-Validation 12-13	8	19.2	99.2	PG	5.46	-22.7	7.02
135	Winter 2012-13	Re-Validation 12-13	8	19.2	99.7	PG	3.99	-22.6	7.12
136	Winter 2012-13	Re-Validation 12-13	8	19.1	100.7	PG	3.37	-22.8	6.77
158	Winter 2012-13	Re-Validation 12-13	8	19.2	101.7	EG	3.43	-17.8	6.45
155	Winter 2012-13	Re-Validation 12-13	8	19.1	101.2	PG	6.40	-17.8	9.31
124	Winter 2012-13	Re-Validation 12-13	8	19.2	100.2	PG	4.71	-21.4	6.73
143	Winter 2012-13	Re-Validation 12-13	8	19.1	99.7	PG	6.21	-23.1	8.35
144	Winter 2012-13	Re-Validation 12-13	8	20.5	98.9	PG	5.96	-23.1	8.15
146	Winter 2012-13	Re-Validation 12-13	8	19.1	100.3	PG	7.99	-23.3	9.49
14	Winter 2021-22	Re-Validation 21-22	8	20.35	98.16	EG	4.77	-18.99	7.78
42	Winter 2021-22	Re-Validation 21-22	8	20.04	100.48	PG	8.30	-4.1	11.21
59	Winter 2021-22	Re-Validation 21-22	8	19.55	100.26	PG	9.40	-10.3	10.68
27	Winter 2021-22	Re-Validation 21-22	8	19.52	98.98	PG	10.50	-14.02	10.59
16	Winter 2021-22	Re-Validation 21-22	8	20.51	98	PG	10.85	-19.64	10.01
3	Winter 2020-21	Re-Validation 21-22	8	19.55	99.51	EG	3.71	-4.81	5.81
117	Winter 2020-21	Re-Validation 21-22	8	19.21	97.58	EG	5.23	-16.8	7.24
24	Winter 2018-19	Re-Validation 21-22	8	18.84	100.47	PG	7.53	-13.65	9.07
5	Winter 2018-19	Re-Validation 21-22	8	18.54	98.87	PG	9.38	-22.58	9.04
15	Winter 2021-22	Re-Validation 21-22	8	20.41	98.32	EG	5.32	-19.09	8.23
17	Winter 2021-22	Re-Validation 21-22	8	20.4	98.62	EG	3.55	-19.81	7.02
3	Winter 2018-19	Re-Validation 21-22	8	18.65	99.4	EG	4.89	-22.8	8.41
7	Winter 2018-19	Re-Validation 21-22	8	18.93	99.23	PG	6.94	-22.38	7.73
44	Winter 2021-22	Re-Validation 21-22	8	19.52	99.83	PG	5.70	-5.1	8.24
29	Winter 2021-22	Re-Validation 21-22	8	19.42	99.69	PG	6.28	-11.47	8.19
18	Winter 2021-22	Re-Validation 21-22	8	20.26	98.51	PG	6.41	-19.91	7.64
24	Winter 2019-20	Re-Validation 21-22	8	19.84	103.46	EG	2.84	-5.04	5.13
8	Winter 2019-20	Re-Validation 21-22	8	19.45	103.16	EG	3.30	-17.03	6.17

Table 7.2: Lift Loss Correlation Re-Validation Analysis

		Lower %LL	Middle %LL	Higher %LL	Comments
Original Correlation Analysis (2009-12)	44 pts	5.4	7.3	9.2	-
Re-Validation data from 2012-13	13 pts	4.8	6.7	8.6	Only 2012-13 pts
Re-Validation data from 2012-13 (no slush data)	9 pts	5.9	7.2	8.6	Only 2012-13 pts (slush pts removed)
Combined 2009-12 + 2012-13 data sets	57 pts	5.3	7.1	9.0	All Data
Combined 2009-12 + 2012-13 data sets (no slush data)	53 pts	5.5	7.3	9.0	All Data (slush pts removed)
Re-Validation data from 2021-22	18 pts	6.6	8.1	9.6	Only 2021-22 pts
All combined data sets (no slush data)	71 pts	5.0	7.6	10.1	44+9+18pts (slush pts removed)
All combined data sets (no ClearWing ECO, no slush data)	**67 pts**	**5.1**	**7.4**	**9.7**	**ClearWing ECO and slush pts removed**
Combined 2009-12 and 2021-22	63 pts	5.1	7.6	10.1	Original 44 pts and New 18 pts
All PG Fluid data	52 pts	5.3	7.7	10.1	-
All EG Fluid data	19 pts	6.0	6.5	7.0	-

Table 7.3: Lift Loss Criteria for High-Speed Tests Conducted with the RJ Wing

Satisfactory	**<5.4% Lift Loss**
Review	**5.4% to 9.2%**
Not Acceptable	**>9.2% Lift Loss**

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8. 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 2021-22.

8.1 Note Related to Small Hail

Currently, all allowance time tables include guidance for Moderate Ice Pellets (or Small Hail). A note related to the determination of small hail is also included in the tables. For the winter of 2022-23, the note will be updated and clarified to better reflect how small hail is being reported by METAR.

8.2 Notes Related to Rotation Speeds

Currently, allowance times are developed for use with high-speed rotation aircraft with a minimum of 100 knots; however, certain conditions with PG fluids require a minimum rotation speed of 115 knots in order to use the allowance time. For the winter of 2022-23, a new note will be added clearly specifying which allowance times must be used with a minimum rotation speed of 100 knots in addition to the existing note for allowance times requiring a minimum rotation speed of 115 knots.

8.3 Change to PG Type IV Adjusted Allowance Time Table

During the yearly updates, an incorrect allowance time value was discovered in the Type IV PG adjusted allowance time table. The allowance time for Moderate Ice Pellets -5°C and above has been published since 2017-18 as 14 minutes; however, the correct value should have been 11 minutes. The revised 2022-23 HOT Guidelines now include the corrected value.

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9. CONCLUSIONS

These conclusions were derived from the testing conducted during the winter of 2021-22.

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

Five new-to-market fluids were tested during the winter of 2021-22.

The results obtained validated the current Type IV allowance times for use with the following new-to-market fluids:

- CHEMCO Inc. ChemR Nordik IV;
- Cryotech Deicing Technology Polar Guard® Xtend;
- JSC RCP Nordix Defrost NORTH 4; and
- Newave Aerochemical Co. Ltd. FCY-EGIV.

Based on the results obtained, the validation testing for ClearWing ECO is considered incomplete. Further discussions with the fluid manufacturer related to the batch submitted, and likely additional testing with a new batch, will be required before any changes to the guidelines are considered.

9.2 Reduction for PG Fluid Allowance Times

Recent data indicated that the current 30-minute allowance time for PG fluids in the condition of Light Ice Pellets below -16ºC to -22ºC can generate higher lift losses nearing or slightly exceeding the acceptable limit. These results are in line with historical data showing higher lift losses in this cell for PG fluids. Therefore, testing was conducted simulating a 20-minute allowance time and the results were more appropriate and acceptable. As a result of the recent data and with support from historical data, a guidance change was recommended to reduce the PG fluid 30-minute allowance time to 20 minutes for Light Ice Pellets below -16ºC to -22ºC.

9.3 Longer Times for Type IV EG Specific Allowance Time Table

Based on the data collected, TC and the FAA agreed to update the separate Type IV EG fluid allowance time table to incorporate the longer times (as shown in Table 5.4) in the below -10ºC to -16ºC range. The changes are expected to be included in the Winter 2022-23 HOT Guidelines.

There is also a potential to develop longer allowance times for Type IV EG fluids below -16°C; however, additional data is required to support the preliminary data collected to date.

9.4 Evaluation of New Mixed Conditions

Data was collected in the mixed conditions Moderate Ice Pellets and Moderate Snow as well as Light Ice Pellets, Light Freezing Rain, and Light Snow. In both mixed conditions, the data collected was limited but indicated a potential for future development. Additional testing with multiple fluids and at different temperatures would be required to develop comprehensive allowance times for these two mixed conditions.

9.5 Re-Validation of Lift Loss Scaling Analysis

The lift loss scaling analysis was verified with 18 new data points. The analysis indicated that the current lift loss criteria remain unchanged and are considered re-validated. In the future, a more in-depth review of EG and PG fluids could be merited. A periodic (i.e., every five years) revisit of this analysis is suggested as new-generation fluids come onto the market.

9.6 Changes to Ice Pellet Allowance Time Guidance

The validation resulted in a reduction to the PG table for Light Ice Pellets below -16°C to -22°C. The EG expansion testing resulted in longer times below -10°C to -16°C. The notes in the respective tables were updated to reflect the content changes. The Type IV PG adjusted table had an allowance time value corrected for Moderate Ice Pellets -5°C and above.

10. RECOMMENDATIONS

The following recommendations were compiled based on the work conducted during the winter of 2021-22 and based on consultations with TC and the FAA.

10.1 Changes to Ice Pellet Allowance Time Guidance

The following changes were made to the Ice Pellet Allowance Time guidance material based on the 2021-22 wind tunnel test results:

- The PG allowance time table includes a reduction from 30 minutes to 20 minutes for Light Ice Pellets below -16°C to -22°C;
- The EG allowance time table includes longer times for Light Ice Pellets, Light Ice Pellets Mixed with Snow, and Moderate Ice Pellets below -10°C to -16°C; and
- The notes in the respective tables have been updated to reflect the content changes.

The updated Winter 2022-23 Type III allowance time table is shown in Table 10.1 for TC and Table 10.2 for the FAA. The EG and PG Type IV tables for the winter of 2022-23 are shown in Table 10.3 and Table 10.4 for TC and Table 10.5 and Table 10.6 for the FAA. It should be noted that the 76 percent adjusted tables were also published by TC and the FAA for those operations where flaps and slats are deployed prior to de/anti-icing; however, these tables have not been included in this report for brevity.

Table 10.1: 2022-23 TC Type III Ice Pellet Allowance Time Table

Transport Canada Holdover Time Guidelines **Winter 2022-2023**

TABLE 50: ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature		
		-5 °C and above	Below -5 to -10 °C	Below -10 °C[3]
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[4]		
Moderate Ice Pellets (or Small Hail[5])	**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 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.

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

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 reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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 cautions that apply to the allowance times in the table above can be found on page 63.

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Table 10.2: 2022-23 FAA Type III Ice Pellet Allowance Time Table

TABLE 50: ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature		
		-5 °C and above	Below -5 to -10 °C	Below -10 °C[3]
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[4]		
Moderate Ice Pellets (or Small Hail[5])	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 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.
3 Ensure that the lowest operational use temperature (LOUT) is respected.
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 reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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 cautions that apply to the allowance times in the table above can be found on page 63.

Table 10.3: 2022-23 TC Type IV EG Ice Pellet Allowance Time Table

Transport Canada Holdover Time Guidelines **Winter 2022-2023**

TABLE 51: ALLOWANCE TIMES FOR SAE TYPE IV ETHYLENE GLYCOL (EG) FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and Above[3]	Below -5 to -10 °C[3]	Below -10 to -16 °C[3]	Below -16 to -22 °C[3,4]
Light Ice Pellets	**-PL**	70 minutes	50 minutes	50 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	50 minutes	30 minutes	25 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[5]			
Moderate Ice Pellets (or Small Hail[6])	**PL, GS**	35 minutes	25 minutes	15 minutes	10 minutes
Moderate Ice Pellets (or Small Hail[6]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ,**	20 minutes	10 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[6]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	15 minutes[7]			

NOTES

1 These allowance times are for use with undiluted (100/0) ethylene glycol based fluids. 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 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.

3 No allowance times exist for ethylene glycol (EG) fluids when used on aircraft with rotation speeds less than 100 knots.

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

5 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.

6 In the US, small hail is reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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.

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

CAUTIONS

- The cautions that apply to the allowance times in the table above can be found on page 63.

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Table 10.4: 2022-23 TC Type IV PG Ice Pellet Allowance Time Table

Transport Canada Holdover Time Guidelines **Winter 2022-2023**

TABLE 52: ALLOWANCE TIMES FOR SAE TYPE IV PROPYLENE GLYCOL (PG) FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and Above[3]	Below -5 to -10 °C[3]	Below -10 to -16 °C[4]	Below -16 to -22 °C[4,5]
Light Ice Pellets	-PL	50 minutes	30 minutes	30 minutes	20 minutes
Light Ice Pellets Mixed with Light Snow	-PLSN, -SNPL	40 minutes	15 minutes	15 minutes	
Light Ice Pellets Mixed with Light Freezing Drizzle or Moderate Freezing Drizzle	-PLFZDZ, -FZDZPL, FZDZPL	25 minutes	10 minutes		
Light Ice Pellets Mixed with Light Freezing Rain	-PLFZRA, -FZRAPL	25 minutes	10 minutes	Caution: No allowance times currently exist	
Light Ice Pellets Mixed with Light Rain	-PLRA, -RAPL	25 minutes[6]			
Moderate Ice Pellets (or Small Hail[7])	PL, GS	15 minutes	10 minutes	10 minutes	
Moderate Ice Pellets (or Small Hail[7]) Mixed with Moderate Freezing Drizzle	PLFZDZ, GSFZDZ	10 minutes	7 minutes	Caution: No allowance times currently exist	
Moderate Ice Pellets (or Small Hail[7]) Mixed with Moderate Rain	PLRA, GSRA, RAPL, RAGS	10 minutes[8]			

NOTES

1 These allowance times are for use with undiluted (100/0) propylene glycol (PG) based fluids. All Type IV fluids are PG 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 (EG) based. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.
2 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.
3 No allowance times exist for propylene glycol (PG) fluids when used on aircraft with rotation speeds less than 100 knots.
4 No allowance times exist for propylene glycol (PG) fluids when used on aircraft with rotation speeds less than 115 knots.
5 Ensure that the lowest operational use temperature (LOUT) is respected.
6 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.
7 In the US, small hail is reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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.
8 No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The cautions that apply to the allowance times in the table above can be found on page 63.

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Table 10.5: 2022-23 FAA Type IV EG Ice Pellet Allowance Time Table

FAA Holdover Time Guidelines **Winter 2022-2023**

TABLE 51: ALLOWANCE TIMES FOR SAE TYPE IV ETHYLENE GLYCOL (EG) FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and above[3]	Below -5 to -10 °C[3]	Below -10 to -16 °C[3]	Below -16 to -22 °C[3,4]
Light Ice Pellets	-PL	70 minutes	50 minutes	50 minutes	30 minutes
Light Ice Pellets Mixed with Light Snow	-PLSN, -SNPL	50 minutes	30 minutes	25 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[5]			
Moderate Ice Pellets (or Small Hail[6])	PL, GS	35 minutes	25 minutes	15 minutes	10 minutes
Moderate Ice Pellets (or Small Hail[6]) Mixed with Moderate Freezing Drizzle	PLFZDZ, GSFZDZ,	20 minutes	10 minutes	Caution: No allowance times currently exist	
Moderate Ice Pellets (or Small Hail[6]) Mixed with Moderate Rain	PLRA, GSRA, RAPL, RAGS	15 minutes[7]			

NOTES

1 These allowance times are for use with undiluted (100/0) EG based fluids. The following fluids are EG 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 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.

3 No allowance times exist for EG based fluids when used on aircraft with rotation speeds less than 100 knots.

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

5 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.

6 In the US, small hail is reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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.

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

CAUTIONS

- The cautions that apply to the allowance times in the table above can be found on page 63.

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Table 10.6: 2022-23 FAA Type IV PG Ice Pellet Allowance Time Table

TABLE 52: ALLOWANCE TIMES FOR SAE TYPE IV PROPYLENE GLYCOL (PG) FLUIDS[1,2]

Precipitation Types or Combinations	Applicable METAR Codes	Outside Air Temperature			
		-5 °C and above[3]	Below -5 to -10 °C[3]	Below -10 to -16 °C[4]	Below -16 to -22 °C[4,5]
Light Ice Pellets	**-PL**	50 minutes	30 minutes	30 minutes	20 minutes
Light Ice Pellets Mixed with Light Snow	**-PLSN, -SNPL**	40 minutes	15 minutes	15 minutes	
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[6]			
Moderate Ice Pellets (or Small Hail[7])	**PL, GS**	15 minutes	10 minutes	10 minutes	
Moderate Ice Pellets (or Small Hail[7]) Mixed with Moderate Freezing Drizzle	**PLFZDZ, GSFZDZ**	10 minutes	7 minutes	**Caution: No allowance times currently exist**	
Moderate Ice Pellets (or Small Hail[7]) Mixed with Moderate Rain	**PLRA, GSRA, RAPL, RAGS**	10 minutes[8]			

NOTES

1. These allowance times are for use with undiluted (100/0) PG based fluids applied on aircraft with rotation speeds of 100 knots or greater. All Type IV fluids are PG 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 EG based. If the glycol type is unknown, the allowance times for SAE Type IV PG fluids should be used.
2. 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.
3. No allowance times exist for PG based fluids when used on aircraft with rotation speeds less than 100 knots.
4. No allowance times exist for PG based fluids when used on aircraft with rotation speeds less than 115 knots.
5. Ensure that the lowest operational use temperature (LOUT) is respected.
6. 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.
7. In the US, small hail is reported by METAR as GR and the remarks section is used to indicate "GR LESS THAN ¼". Outside of the US the METAR code GS is used to indicate small hail when it is less than 5 mm and GR to indicate hail when it is 5mm or greater. If METAR does not report an intensity for small hail, use the "moderate ice pellets or small hail" allowance times. If METAR reports an intensity 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.
8. No allowance times exist in this condition for temperatures of 0 °C and below.

CAUTIONS

- The cautions that apply to the allowance times in the table above can be found on page 63.

10.2 Future Research

This subsection 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.

10.2.1 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 AllClear Systems LLC ClearWing ECO to address the incomplete data collected during the winter of 2021-22.

10.2.2 Allowance Time Expansion

The recent EG expansion work has indicated that there is still potential to expand the allowance times for EG fluids below -16ºC; 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, as well as mixed conditions, for both Type III and Type IV fluids. The conditions to be targeted should be coordinated with the efforts of the METAR Working Group that has identified mixed conditions of interest based on frequency of occurrence and operational impact.

10.2.3 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 2021-22

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.

11. Wind Tunnel Testing – Week 1 Activities (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 program element includes pre-testing activities and post-testing activities (including reporting and analysis) related to all wind tunnel testing activities. It also includes 5 days of testing.

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

b) Perform wind tunnel tests with the RJ, LS-0417, or the vertical stabilizer common research model. 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. Further development of the EG-specific allowance time table to be able to benefit from potentially longer times;

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

   iv. Evaluation of contaminated fluid flow-off from a vertical stabilizer.

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 takeoff runs. 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. 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.

c) Analyse data.

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

12. Wind Tunnel Testing – Week 2 Activities (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 program element includes 5 days of testing. The related pre-testing and post-testing activities (including reporting and analysis) are associated with program element #11.

a) Perform wind tunnel tests with the RJ, LS-0417, or the vertical stabilizer common research model. 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. Further development of the EG-specific allowance time table to be able to benefit from potentially longer times;

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

   iv. Evaluation of contaminated fluid flow-off from a vertical stabilizer.

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 takeoff runs. 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. 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.

13. Wind Tunnel Testing – Week 3 Activities (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 program element includes 5 days of testing. The related pre-testing and post-testing activities (including reporting and analysis) are associated with program element #11.

a) Perform wind tunnel tests with the RJ, LS-0417, or the vertical stabilizer common research model. 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. Further development of the EG-specific allowance time table to be able to benefit from potentially longer times;

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

   iv. Evaluation of contaminated fluid flow-off from a vertical stabilizer.

   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 takeoff runs. 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. 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.

14. Wind Tunnel Testing – Week 4 Activities (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 program element includes 5 days of testing. The related pre-testing and post-testing activities (including reporting and analysis) are associated with program element #11.

a) Perform wind tunnel tests with the RJ, LS-0417, or the vertical stabilizer common research model. 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. Further development of the EG-specific allowance time table to be able to benefit from potentially longer times;
   iii. Expansion of the allowance for Type III fluids at lower speeds to get longer times and guidance in more conditions; and
   iv. Evaluation of contaminated fluid flow-off from a vertical stabilizer.

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 takeoff runs. 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. 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.

15. Wind Tunnel Testing – Week 5 Activities (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 program element includes 5 days of testing. The related pre-testing and post-testing activities (including reporting and analysis) are associated with program element #11.

a) Perform wind tunnel tests with the RJ, LS-0417, or the vertical stabilizer common research model. 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. Further development of the EG-specific allowance time table to be able to benefit from potentially longer times;

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

   iv. Evaluation of contaminated fluid flow-off from a vertical stabilizer.

   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 takeoff runs. 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. 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.

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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 2021-22

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PROCEDURE:

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

Winter 2021-22

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

APS Aviation Inc.

December 15, 2021
Final Version 1.0

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

Winter 2021-22

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 Icing Wind Tunnel (IWT) 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 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 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 IWT 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 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. Research at the IWT with and without ice pellets has continued on a yearly or bi-yearly basis and is performed by APS, with support from the NRC, on behalf of TC/FAA.

For the Winter 2021-22, testing will continue the development of ice pellet allowance times.

2. OBJECTIVES AND TIMING

The following describes the objectives and timing of the research. Twenty-four days of testing are being planned based on TC/FAA funding resources, fifteen days of which are reserved for testing with the thin high-performance regional jet (RJ) wing section. The sequence of testing is fixed due to availability of the wind tunnel and NRC personnel required to swap out the aerodynamic models (vertical stabilizer vs. wing).

2.1 Type IV Allowance Time Validation Testing

The objective of this testing is to conduct aerodynamic testing with a thin high performance RJ wing section 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 IWT. The dimensions indicated are in inches. This wing section was constructed by the 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.

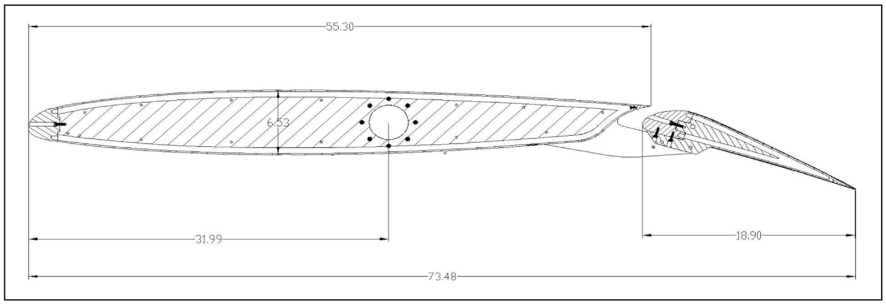

Figure 2.1: Thin High Performance Wing Section

Approximately eight 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 IWT.

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

2.3 General Allowance Time Expansion

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

- Expand the current allowance times to include new temperature bands and new conditions.

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 IWT.

It should be noted that for the purposes of the test plan, these general expansion tests have been separated into propylene glycol (PG) and EG Expansion Type IV tests and labeled as such. These tests currently include:

- Mixed Moderate Ice Pellets and Moderate Snow for PG and EG fluids;
- Mixed Light Ice Pellets Mixed with Light Snow, below -16 to -22°C, for PG and EG fluids; and
- Longer allowance times for PG fluids.

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

2.4 Documentation of Contaminated Fluid Flow-Off on a Vertical Stabilizer

As part of a separate project, aerodynamic testing with a thin common research model vertical stabilizer will be conducted to document contaminated fluid flow-off on a vertical stabilizer. Nine days of testing at the start of the testing campaign are required for the conduct of these tests, the details of which are provided in a separate procedure.

2.5 Timing

Fifteen days are required for the "Ice Pellet Allowance Time Testing" (Subsections 2.1, 2.2, and 2.3), and nine days are required for the "Documentation of Contaminated Fluid Flow-Off on a Vertical Stabilizer" (Subsection 2.4). This totals to 24 days of testing, based on the available TC/FAA funding resources.

At the time of writing this procedure, it is expected that testing with the RJ model will start on January 9th, 2022. Changing over of the aerodynamic models will require some down-time which will occur during the week of January 30th. Testing will resume with the CRM model (details described in a separate procedure) for an additional nine days of testing starting February 3rd. See Table 2.1 for details.

Testing will be conducted during overnight periods (9:30 pm to 5:30 am), with the exception of the weeks of December 19th, January 30th, and February 13th, which will be from 8:00 am to 4:00 pm. The weekends will be considered only if deemed necessary. The first two hours or more of the first day will be dedicated to setup and calibration of the rain sprayer and ice pellet and snow dispensers; time permitting testing will begin as per the test plan.

Table 2.1: Test Calendar

Week of	Sun	Mon	Tue	Wed	Thurs	Fri	Sat
19-Dec-21		APS Setup, Training, and Precip. Calibration	APS Setup, Training, and Precip. Calibration	Backup-day			
26-Dec-21							
02-Jan-22							
09-Jan-22	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests		
16-Jan-22	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests		
23-Jan-22	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests	APS RJ Fluid Tests		
30-Jan-22		Wing Changeover (no testing)	Wing Changeover (no testing)	Wing Changeover (no testing)	NRC CRM Shakedown and Calibration - Dry Runs	NRC CRM Shakedown and Calibration - Tufts	
06-Feb-22	APS CRM Fluid Tests	APS CRM Fluid Tests	APS CRM Fluid Tests	APS CRM Fluid Tests	APS CRM Fluid Tests		
13-Feb-22		NRC CRM Shakedown and Calibration -BL Tests	NRC CRM Shakedown and Calibration -BL Tests				

Note: Planned for 25 days. Revised to 24 based on scheduling availibilty.

Legend

APS Setup, Training, and Precip. Calibration	APS to setup equipment, setup remote vieweing cameras, conduct training for new staff, and (if possible) conduct calibration of precipitation dispensing.
NRC CRM Shakedown and Calibration	NRC lead activity to deliver a working and repeatable CRM model. APS to support. 1 day Shakedown and Dry Run Repeatability. 2 days Boundary Layer Rake Tests. 1 day Tuft tests.
Backup NRC week	Optional days for NRC Shakedown and Calibration in case of delays
APS CRM Fluid Tests	Fluid only, and fluid with contamination tests (SN, FZRA, PL). Up to 5 days
Wing Changeover (no testing)	NRC needs time to changover the CRM to the RJ wing.
APS RJ Fluid Tests	Ice pellet allowance time and related testing. 15 days.

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 Items #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.

Table 3.1: Preliminary List of Testing Objectives for Winter 2021-22 Wind Tunnel Testing

Item #	Objective	Priority	Description	# of Days
0	Setup 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	CRM V-Stab - Calibration and Characterization Testing	1	Shakedown and dry run repeatability, boundary layer rake tests, and tuft tests.	4
3	CRM V-Stab - Fluid Testing	1	Fluid only, and fluid with contamination tests (SN, FZRA, PL).	5
4	Type IV IP AT Validation (New Fluids)	1	Substantiate current times with new fluids.	8
5	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.	4
6	General Allowance Time Expansion		New temperatures, conditions, etc. for allowance times i.e., Moderate snow mixed with ice pellets.	3
7	Other R&D Activities	2	Could be selected from item # 7.1 to 7.7.	0
7.1	METAR		Triplicate conditions and testing to support MWG activities.	-
7.2	Type III Allowance Time Expansion	-	Expand the current Type III allowance times to have increased times, or more cells.	-
7.3	Type III Low Speed Allowance Times	-	Validate the current Type III allowance times for use with low speed aircraft.	-
7.4	Heavy Snow	-	Continue Heavy Snow Research comparing lift losses with Light/Moderate Snow vs. Heavy Snow.	-
7.5	Heavy Contamination (Aero vs. Visual Failure)	-	Continue work looking at aerodynamic failure vs. HOT defined failure, and effect of surface roughness on lift degradation.	-
7.6	Fluid + Contamination @ LOUT	-	Effect of contamination on fluid performance at LOUT with IP, SN, ZF, Frost etc.	-
7.7	Other	-	Any potential suggestions from industry.	-

Total # of Days for Priority 1 Tests	**24**

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/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/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-	8	100	>-5	4Flite EG	25	-	-	-	70	1	
P004	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	4Flite EG	25	10	-	-	50	1	
P005	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	4Flite EG	25	-	13	-	40	2	
P006	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	4Flite EG	25	-	25	-	40	1	
P007	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	4Flite EG	25	-	-	25	40	2	
P008	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	4Flite EG	75	-	-	-	35	1	
P009	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	4Flite EG	75	-	13	-	20	1	
P010	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	4Flite EG	75	-	-	75	15	2	
P011	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	4Flite EG	25	-	-	-	50	2	
P012	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	4Flite EG	25	10	-	-	30	2	
P013	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	4Flite EG	25	-	13	-	30	2	
P014	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	4Flite EG	25	-	25	-	30	1	
P015	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	4Flite EG	75	-	-	-	25	2	
P016	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	4Flite EG	75	-	13	-	10	1	
P017	Type IV Validation and New Fluids	1	IP-	8	100	-10 to -16	4Flite EG	25	-	-	-	30	1	
P018	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-10 to -16	4Flite EG	25	10	-	-	15	1	
P019	Type IV Validation and New Fluids	1	IP Mod	8	100	-10 to -16	4Flite EG	75	-	-	-	10	1	
P020	Type IV Validation and New Fluids	1	IP-	8	100	-16 to -22	4Flite EG	25	-	-	-	30	2	
P021	Type IV Validation and New Fluids	1	IP Mod	8	100	-16 to -22	4Flite EG	75	-	-	-	10	2	
P022	Type IV Validation and New Fluids	1	IP-	8	100	<-22	4Flite EG	25	-	-	-	30	2	No AT exists currently
P023	Type IV Validation and New Fluids	1	IP Mod	8	100	<-22	4Flite EG	75	-	-	-	10	2	No AT exists currently
P024	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	4Flite EG	-	-	-	-	-	2	Baseline Test
P025	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	4Flite EG	-	-	-	-	-	1	Baseline Test
P026	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	4Flite 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/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P027	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	4Flite EG	-	-	-	-	-	1	Baseline Test
P028	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	4Flite EG	-	-	-	-	-	1	Baseline Test
P029	Type IV Validation and New Fluids	1	IP-	8	100	>-5	AVIAFlight EG	25	-	-	-	70	1	
P030	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	AVIAFlight EG	25	10	-	-	50	1	
P031	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	AVIAFlight EG	25	-	13	-	40	2	
P032	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	AVIAFlight EG	25	-	25	-	40	1	
P033	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	AVIAFlight EG	25	-	-	25	40	2	
P034	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	AVIAFlight EG	75	-	-	-	35	1	
P035	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	AVIAFlight EG	75	-	13	-	20	1	
P036	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	AVIAFlight EG	75	-	-	75	15	2	
P037	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	AVIAFlight EG	25	-	-	-	50	2	
P038	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	AVIAFlight EG	25	10	-	-	30	2	
P039	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	AVIAFlight EG	25	-	13	-	30	2	
P040	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	AVIAFlight EG	25	-	25	-	30	1	
P041	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	AVIAFlight EG	75	-	-	-	25	2	
P042	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	AVIAFlight EG	75	-	13	-	10	1	
P043	Type IV Validation and New Fluids	1	IP-	8	100	-10 to -16	AVIAFlight EG	25	-	-	-	30	1	
P044	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-10 to -16	AVIAFlight EG	25	10	-	-	15	1	
P045	Type IV Validation and New Fluids	1	IP Mod	8	100	-10 to -16	AVIAFlight EG	75	-	-	-	10	1	
P046	Type IV Validation and New Fluids	1	IP-	8	100	-16 to -22	AVIAFlight EG	25	-	-	-	30	2	
P047	Type IV Validation and New Fluids	1	IP Mod	8	100	-16 to -22	AVIAFlight EG	75	-	-	-	10	2	
P048	Type IV Validation and New Fluids	1	IP-	8	100	<-22	AVIAFlight EG	25	-	-	-	30	2	No AT exists currently
P049	Type IV Validation and New Fluids	1	IP Mod	8	100	<-22	AVIAFlight EG	75	-	-	-	10	2	No AT exists currently
P050	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	AVIAFlight EG	-	-	-	-	-	2	Baseline Test
P051	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	AVIAFlight EG	-	-	-	-	-	1	Baseline Test
P052	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	AVIAFlight 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
P053	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	AVIAFlight EG	-	-	-	-	-	1	Baseline Test
P054	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	AVIAFlight EG	-	-	-	-	-	1	Baseline Test
P055	Type IV Validation and New Fluids	1	IP-	8	100	>-5	ChemR Nordik IV	25	-	-	-	70	1	
P056	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	ChemR Nordik IV	25	10	-	-	50	1	
P057	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	ChemR Nordik IV	25	-	13	-	40	2	
P058	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	ChemR Nordik IV	25	-	25	-	40	1	
P059	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	ChemR Nordik IV	25	-	-	25	40	2	
P060	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	ChemR Nordik IV	75	-	-	-	35	1	
P061	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	ChemR Nordik IV	75	-	13	-	20	1	
P062	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	ChemR Nordik IV	75	-	-	75	15	2	
P063	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	ChemR Nordik IV	25	-	-	-	50	2	
P064	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	ChemR Nordik IV	25	10	-	-	30	2	
P065	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	ChemR Nordik IV	25	-	13	-	30	2	
P066	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	ChemR Nordik IV	25	-	25	-	30	1	
P067	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	ChemR Nordik IV	75	-	-	-	25	2	
P068	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	ChemR Nordik IV	75	-	13	-	10	1	
P069	Type IV Validation and New Fluids	1	IP-	8	100	-10 to -16	ChemR Nordik IV	25	-	-	-	30	1	
P070	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-10 to -16	ChemR Nordik IV	25	10	-	-	15	1	
P071	Type IV Validation and New Fluids	1	IP Mod	8	100	-10 to -16	ChemR Nordik IV	75	-	-	-	10	1	
P072	Type IV Validation and New Fluids	1	IP-	8	100	-16 to -22	ChemR Nordik IV	25	-	-	-	30	2	
P073	Type IV Validation and New Fluids	1	IP Mod	8	100	-16 to -22	ChemR Nordik IV	75	-	-	-	10	2	
P074	Type IV Validation and New Fluids	1	IP-	8	100	<-22	ChemR Nordik IV	25	-	-	-	30	2	No AT exists currently
P075	Type IV Validation and New Fluids	1	IP Mod	8	100	<-22	ChemR Nordik IV	75	-	-	-	10	2	No AT exists currently
P076	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	ChemR Nordik IV	-	-	-	-	-	2	Baseline Test
P077	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	ChemR Nordik IV	-	-	-	-	-	1	Baseline Test
P078	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	ChemR Nordik 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
P079	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	ChemR Nordik IV	-	-	-	-	-	1	Baseline Test
P080	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	ChemR Nordik IV	-	-	-	-	-	1	Baseline Test
P081	Type IV Validation and New Fluids	1	IP-	8	100	>-5	Defrost NORTH 4	25	-	-	-	70	1	
P082	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	Defrost NORTH 4	25	10	-	-	50	1	
P083	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	Defrost NORTH 4	25	-	13	-	40	2	
P084	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	Defrost NORTH 4	25	-	25	-	40	1	
P085	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	Defrost NORTH 4	25	-	-	25	40	2	
P086	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	Defrost NORTH 4	75	-	-	-	35	1	
P087	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	Defrost NORTH 4	75	-	13	-	20	1	
P088	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	Defrost NORTH 4	75	-	-	75	15	2	
P089	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	Defrost NORTH 4	25	-	-	-	50	2	
P090	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	Defrost NORTH 4	25	10	-	-	30	2	
P091	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	Defrost NORTH 4	25	-	13	-	30	2	
P092	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	Defrost NORTH 4	25	-	25	-	30	1	
P093	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	Defrost NORTH 4	75	-	-	-	25	2	
P094	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	Defrost NORTH 4	75	-	13	-	10	1	
P095	Type IV Validation and New Fluids	1	IP-	8	100	-10 to -16	Defrost NORTH 4	25	-	-	-	30	1	
P096	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-10 to -16	Defrost NORTH 4	25	10	-	-	15	1	
P097	Type IV Validation and New Fluids	1	IP Mod	8	100	-10 to -16	Defrost NORTH 4	75	-	-	-	10	1	
P098	Type IV Validation and New Fluids	1	IP-	8	100	-16 to -22	Defrost NORTH 4	25	-	-	-	30	2	
P099	Type IV Validation and New Fluids	1	IP Mod	8	100	-16 to -22	Defrost NORTH 4	75	-	-	-	10	2	
P100	Type IV Validation and New Fluids	1	IP-	8	100	<-22	Defrost NORTH 4	25	-	-	-	30	2	No AT exists currently
P101	Type IV Validation and New Fluids	1	IP Mod	8	100	<-22	Defrost NORTH 4	75	-	-	-	10	2	No AT exists currently
P102	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	Defrost NORTH 4	-	-	-	-	-	2	Baseline Test
P103	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	Defrost NORTH 4	-	-	-	-	-	1	Baseline Test
P104	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	Defrost NORTH 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
P105	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	Defrost NORTH 4	-	-	-	-	-	1	Baseline Test
P106	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	Defrost NORTH 4	-	-	-	-	-	1	Baseline Test
P107	Type IV Validation and New Fluids	1	IP-	8	100	>-5	ClearWing ECO	25	-	-	-	50	1	
P108	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	ClearWing ECO	25	10	-	-	40	1	
P109	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	ClearWing ECO	25	-	13	-	25	2	
P110	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	ClearWing ECO	25	-	25	-	25	1	
P111	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	ClearWing ECO	25	-	-	25	25	2	
P112	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	ClearWing ECO	75	-	-	-	15	1	
P113	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	ClearWing ECO	75	-	13	-	10	1	
P114	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	ClearWing ECO	75	-	-	75	10	2	
P115	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	ClearWing ECO	25	-	-	-	30	2	
P116	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	ClearWing ECO	25	10	-	-	15	2	
P117	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	ClearWing ECO	25	-	13	-	10	2	
P118	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	ClearWing ECO	25	-	25	-	10	1	
P119	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	ClearWing ECO	75	-	-	-	10	2	
P120	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	ClearWing ECO	75	-	13	-	7	1	
P121	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	ClearWing ECO	25	-	-	-	30	1	115knts for PG
P122	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	ClearWing ECO	25	10	-	-	15	1	115knts for PG
P123	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	ClearWing ECO	75	-	-	-	10	1	115knts for PG
P124	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	ClearWing ECO	25	-	-	-	30	2	115knts for PG
P125	Type IV Validation and New Fluids	1	IP-	8	115	<-22	ClearWing ECO	25	-	-	-	30	2	115knts for PG. No AT exist.
P126	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	ClearWing ECO	-	-	-	-	-	2	Baseline Test
P127	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	ClearWing ECO	-	-	-	-	-	1	Baseline Test
P128	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	ClearWing ECO	-	-	-	-	-	2	Baseline Test
P129	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	ClearWing ECO	-	-	-	-	-	1	Baseline Test
P130	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	ClearWing ECO	-	-	-	-	-	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/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P131	Type IV Validation and New Fluids	1	IP-	8	100	>-5	4Flite PG	25	-	-	-	50	1	
P132	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	4Flite PG	25	10	-	-	40	1	
P133	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	4Flite PG	25	-	13	-	25	2	
P134	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	4Flite PG	25	-	25	-	25	1	
P135	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	4Flite PG	25	-	-	25	25	2	
P136	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	4Flite PG	75	-	-	-	15	1	
P137	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	4Flite PG	75	-	13	-	10	1	
P138	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	4Flite PG	75	-	-	75	10	2	
P139	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	4Flite PG	25	-	-	-	30	2	
P140	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	4Flite PG	25	10	-	-	15	2	
P141	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	4Flite PG	25	-	13	-	10	2	
P142	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	4Flite PG	25	-	25	-	10	1	
P143	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	4Flite PG	75	-	-	-	10	2	
P144	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	4Flite PG	75	-	13	-	7	1	
P145	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	4Flite PG	25	-	-	-	30	1	115knts for PG
P146	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	4Flite PG	25	10	-	-	15	1	115knts for PG
P147	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	4Flite PG	75	-	-	-	10	1	115knts for PG
P148	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	4Flite PG	25	-	-	-	30	2	115knts for PG
P149	Type IV Validation and New Fluids	1	IP-	8	115	<-22	4Flite PG	25	-	-	-	30	2	115knts for PG. No AT exist.
P150	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	4Flite PG	-	-	-	-	-	2	Baseline Test
P151	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	4Flite PG	-	-	-	-	-	1	Baseline Test
P152	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	4Flite PG	-	-	-	-	-	2	Baseline Test
P153	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	4Flite PG	-	-	-	-	-	1	Baseline Test
P154	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	4Flite PG	-	-	-	-	-	1	Baseline Test
P155	Type IV Validation and New Fluids	1	IP-	8	100	>-5	AVIAFlight PG	25	-	-	-	50	1	
P156	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	AVIAFlight PG	25	10	-	-	40	1	

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
P157	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	AVIAFlight PG	25	-	13	-	25	2	
P158	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	AVIAFlight PG	25	-	25	-	25	1	
P159	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	AVIAFlight PG	25	-	-	25	25	2	
P160	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	AVIAFlight PG	75	-	-	-	15	1	
P161	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	AVIAFlight PG	75	-	13	-	10	1	
P162	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	AVIAFlight PG	75	-	-	75	10	2	
P163	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	AVIAFlight PG	25	-	-	-	30	2	
P164	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	AVIAFlight PG	25	10	-	-	15	2	
P165	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	AVIAFlight PG	25	-	13	-	10	2	
P166	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	AVIAFlight PG	25	-	25	-	10	1	
P167	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	AVIAFlight PG	75	-	-	-	10	2	
P168	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	AVIAFlight PG	75	-	13	-	7	1	
P169	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	AVIAFlight PG	25	-	-	-	30	1	115knts for PG
P170	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	AVIAFlight PG	25	10	-	-	15	1	115knts for PG
P171	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	AVIAFlight PG	75	-	-	-	10	1	115knts for PG
P172	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	AVIAFlight PG	25	-	-	-	30	2	115knts for PG
P173	Type IV Validation and New Fluids	1	IP-	8	115	<-22	AVIAFlight PG	25	-	-	-	30	2	115knts for PG. No AT exist.
P174	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	AVIAFlight PG	-	-	-	-	-	2	Baseline Test
P175	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P176	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	AVIAFlight PG	-	-	-	-	-	2	Baseline Test
P177	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P178	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P179	Type IV Validation and New Fluids	1	IP-	8	100	>-5	FCY-EGIV	25	-	-	-	50	1	
P180	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	FCY-EGIV	25	10	-	-	40	1	
P181	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	FCY-EGIV	25	-	13	-	25	2	
P182	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	FCY-EGIV	25	-	25	-	25	1	

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
P183	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	FCY-EGIV	25	-	-	25	25	2	
P184	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	FCY-EGIV	75	-	-	-	15	1	
P185	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	FCY-EGIV	75	-	13	-	10	1	
P186	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	FCY-EGIV	75	-	-	75	10	2	
P187	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	FCY-EGIV	25	-	-	-	30	2	
P188	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	FCY-EGIV	25	10	-	-	15	2	
P189	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	FCY-EGIV	25	-	13	-	10	2	
P190	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	FCY-EGIV	25	-	25	-	10	1	
P191	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	FCY-EGIV	75	-	-	-	10	2	
P192	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	FCY-EGIV	75	-	13	-	7	1	
P193	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	FCY-EGIV	25	-	-	-	30	1	115knts for PG
P194	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	FCY-EGIV	25	10	-	-	15	1	115knts for PG
P195	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	FCY-EGIV	75	-	-	-	10	1	115knts for PG
P196	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	FCY-EGIV	25	-	-	-	30	2	115knts for PG
P197	Type IV Validation and New Fluids	1	IP-	8	115	<-22	FCY-EGIV	25	-	-	-	30	2	115knts for PG. No AT exist.
P198	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	FCY-EGIV	-	-	-	-	-	2	Baseline Test
P199	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	FCY-EGIV	-	-	-	-	-	1	Baseline Test
P200	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	FCY-EGIV	-	-	-	-	-	2	Baseline Test
P201	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	FCY-EGIV	-	-	-	-	-	1	Baseline Test
P202	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	FCY-EGIV	-	-	-	-	-	1	Baseline Test
P203	Type IV Validation and New Fluids	1	IP-	8	100	>-5	Polar Guard® Xtend	25	-	-	-	50	1	
P204	Type IV Validation and New Fluids	1	IP- / SN-	8	100	>-5	Polar Guard® Xtend	25	10	-	-	40	1	
P205	Type IV Validation and New Fluids	1	IP- / ZD	8	100	>-5	Polar Guard® Xtend	25	-	13	-	25	2	
P206	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	>-5	Polar Guard® Xtend	25	-	25	-	25	1	
P207	Type IV Validation and New Fluids	1	IP- / R-	8	100	>0	Polar Guard® Xtend	25	-	-	25	25	2	
P208	Type IV Validation and New Fluids	1	IP Mod	8	100	>-5	Polar Guard® Xtend	75	-	-	-	15	1	

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
P209	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	>-5	Polar Guard® Xtend	75	-	13	-	10	1	
P210	Type IV Validation and New Fluids	1	IP Mod / R	8	100	>0	Polar Guard® Xtend	75	-	-	75	10	2	
P211	Type IV Validation and New Fluids	1	IP-	8	100	-5 to -10	Polar Guard® Xtend	25	-	-	-	30	2	
P212	Type IV Validation and New Fluids	1	IP- / SN-	8	100	-5 to -10	Polar Guard® Xtend	25	10	-	-	15	2	
P213	Type IV Validation and New Fluids	1	IP- / ZD	8	100	-5 to -10	Polar Guard® Xtend	25	-	13	-	10	2	
P214	Type IV Validation and New Fluids	1	IP- / ZR-	8	100	-5 to -10	Polar Guard® Xtend	25	-	25	-	10	1	
P215	Type IV Validation and New Fluids	1	IP Mod	8	100	-5 to -10	Polar Guard® Xtend	75	-	-	-	10	2	
P216	Type IV Validation and New Fluids	1	IP Mod/ZD	8	100	-5 to -10	Polar Guard® Xtend	75	-	13	-	7	1	
P217	Type IV Validation and New Fluids	1	IP-	8	115	-10 to -16	Polar Guard® Xtend	25	-	-	-	30	1	115knts for PG
P218	Type IV Validation and New Fluids	1	IP- / SN-	8	115	-10 to -16	Polar Guard® Xtend	25	10	-	-	15	1	115knts for PG
P219	Type IV Validation and New Fluids	1	IP Mod	8	115	-10 to -16	Polar Guard® Xtend	75	-	-	-	10	1	115knts for PG
P220	Type IV Validation and New Fluids	1	IP-	8	115	-16 to -22	Polar Guard® Xtend	25	-	-	-	30	2	115knts for PG
P221	Type IV Validation and New Fluids	1	IP-	8	115	<-22	Polar Guard® Xtend	25	-	-	-	30	2	115knts for PG. No AT exist.
P222	Type IV Validation and New Fluids	1	Fluid Only	8	100	>-5	Polar Guard® Xtend	-	-	-	-	-	2	Baseline Test
P223	Type IV Validation and New Fluids	1	Fluid Only	8	100	-5 to -10	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P224	Type IV Validation and New Fluids	1	Fluid Only	8	100	-10 to -16	Polar Guard® Xtend	-	-	-	-	-	2	Baseline Test
P225	Type IV Validation and New Fluids	1	Fluid Only	8	100	-16 to -22	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P226	Type IV Validation and New Fluids	1	Fluid Only	8	100	<-22	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P227	EG Type IV Expansion	1	IP-	8	100	>-5	DOW EG106	25	-	-	-	90	1	Current AT is 70 min
P228	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	DOW EG106	25	10	-	-	60	1	Current AT is 50 min
P229	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	DOW EG106	25	-	13	-	45	2	Current AT is 40 min
P230	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	DOW EG106	25	-	25	-	45	1	Current AT is 40 min
P231	EG Type IV Expansion	1	IP- / R-	8	100	>0	DOW EG106	25	-	-	25	45	2	Current AT is 40 min
P232	EG Type IV Expansion	1	IP Mod	8	100	>-5	DOW EG106	75	-	-	-	45	1	Current AT is 35 min
P233	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	DOW EG106	75	-	13	-	30	1	Current AT is 20 min
P234	EG Type IV Expansion	1	IP Mod / R	8	100	>0	DOW EG106	75	-	-	75	20	2	Current AT is 15 min

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
P235	EG Type IV Expansion	1	IP / SN	8	100	>-5	DOW EG106	75	25	-	-	10	1	No AT exists currently
P236	EG Type IV Expansion	1	IP-	8	100	-5 to -10	DOW EG106	25	-	-	-	70	2	Current AT is 50 min
P237	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	DOW EG106	25	10	-	-	45	2	Current AT is 30 min
P238	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	DOW EG106	25	-	13	-	40	2	Current AT is 30 min
P239	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	DOW EG106	25	-	25	-	40	1	Current AT is 30 min
P240	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	DOW EG106	75	-	-	-	40	2	Current AT is 25 min
P241	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	DOW EG106	75	-	13	-	20	1	Current AT is 10 min
P242	EG Type IV Expansion	1	IP / SN	8	100	-5 to -10	DOW EG106	75	25	-	-	10	1	No AT exists currently
P243	EG Type IV Expansion	1	IP-	8	100	-10 to -16	DOW EG106	25	-	-	-	50	1	Current AT is 30 min
P244	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	DOW EG106	25	10	-	-	30	1	Current AT is 15 min
P245	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	DOW EG106	75	-	-	-	25	1	Current AT is 10 min
P246	EG Type IV Expansion	1	IP-	8	100	-16 to -22	DOW EG106	25	-	-	-	50	2	Current AT is 30 min
P247	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	DOW EG106	25	10	-	-	15	1	No AT exists currently
P248	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	DOW EG106	75	-	-	-	25	2	Current AT is 30 min
P249	EG Type IV Expansion	1	IP-	8	100	<-22	DOW EG106	25	-	-	-	50	2	No AT exists currently
P250	EG Type IV Expansion	1	IP Mod	8	100	<-22	DOW EG106	75	-	-	-	25	2	No AT exists currently
P251	EG Type IV Expansion	1	Fluid Only	8	100	>-5	DOW EG106	-	-	-	-	-	2	Baseline Test
P252	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	DOW EG106	-	-	-	-	-	1	Baseline Test
P253	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	DOW EG106	-	-	-	-	-	2	Baseline Test
P254	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	DOW EG106	-	-	-	-	-	1	Baseline Test
P255	EG Type IV Expansion	1	Fluid Only	8	100	<-22	DOW EG106	-	-	-	-	-	1	Baseline Test
P256	EG Type IV Expansion	1	IP-	8	100	>-5	ClearWing EG	25	-	-	-	90	1	Current AT is 70 min
P257	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	ClearWing EG	25	10	-	-	60	1	Current AT is 50 min
P258	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	ClearWing EG	25	-	13	-	45	2	Current AT is 40 min
P259	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	ClearWing EG	25	-	25	-	45	1	Current AT is 40 min
P260	EG Type IV Expansion	1	IP- / R-	8	100	>0	ClearWing EG	25	-	-	25	45	2	Current AT is 40 min

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
P261	EG Type IV Expansion	1	IP Mod	8	100	>-5	ClearWing EG	75	-	-	-	45	1	Current AT is 35 min
P262	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	ClearWing EG	75	-	13	-	30	1	Current AT is 20 min
P263	EG Type IV Expansion	1	IP Mod / R	8	100	>0	ClearWing EG	75	-	-	75	20	2	Current AT is 15 min
P264	EG Type IV Expansion	1	IP / SN	8	100	>-5	ClearWing EG	75	25	-	-	10	1	No AT exists currently
P265	EG Type IV Expansion	1	IP-	8	100	-5 to -10	ClearWing EG	25	-	-	-	70	2	Current AT is 50 min
P266	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	ClearWing EG	25	10	-	-	45	2	Current AT is 30 min
P267	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	ClearWing EG	25	-	13	-	40	2	Current AT is 30 min
P268	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	ClearWing EG	25	-	25	-	40	1	Current AT is 30 min
P269	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	ClearWing EG	75	-	-	-	40	2	Current AT is 25 min
P270	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	ClearWing EG	75	-	13	-	20	1	Current AT is 10 min
P271	EG Type IV Expansion	1	IP / SN	8	100	-5 to -10	ClearWing EG	75	25	-	-	10	1	No AT exists currently
P272	EG Type IV Expansion	1	IP-	8	100	-10 to -16	ClearWing EG	25	-	-	-	50	1	Current AT is 30 min
P273	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	ClearWing EG	25	10	-	-	30	1	Current AT is 15 min
P274	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	ClearWing EG	75	-	-	-	25	1	Current AT is 10 min
P275	EG Type IV Expansion	1	IP-	8	100	-16 to -22	ClearWing EG	25	-	-	-	50	2	Current AT is 30 min
P276	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	ClearWing EG	25	10	-	-	15	1	No AT exists currently
P277	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	ClearWing EG	75	-	-	-	25	2	Current AT is 30 min
P278	EG Type IV Expansion	1	IP-	8	100	<-22	ClearWing EG	25	-	-	-	50	2	No AT exists currently
P279	EG Type IV Expansion	1	IP Mod	8	100	<-22	ClearWing EG	75	-	-	-	25	2	No AT exists currently
P280	EG Type IV Expansion	1	Fluid Only	8	100	>-5	ClearWing EG	-	-	-	-	-	2	Baseline Test
P281	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	ClearWing EG	-	-	-	-	-	1	Baseline Test
P282	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	ClearWing EG	-	-	-	-	-	2	Baseline Test
P283	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P284	EG Type IV Expansion	1	Fluid Only	8	100	<-22	ClearWing EG	-	-	-	-	-	1	Baseline Test
P285	EG Type IV Expansion	1	IP-	8	100	>-5	Max Flight AVIA	25	-	-	-	90	1	Current AT is 70 min
P286	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	Max Flight AVIA	25	10	-	-	60	1	Current AT is 50 min

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
P287	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	Max Flight AVIA	25	-	13	-	45	2	Current AT is 40 min
P288	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Max Flight AVIA	25	-	25	-	45	1	Current AT is 40 min
P289	EG Type IV Expansion	1	IP- / R-	8	100	>0	Max Flight AVIA	25	-	-	25	45	2	Current AT is 40 min
P290	EG Type IV Expansion	1	IP Mod	8	100	>-5	Max Flight AVIA	75	-	-	-	45	1	Current AT is 35 min
P291	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Max Flight AVIA	75	-	13	-	30	1	Current AT is 20 min
P292	EG Type IV Expansion	1	IP Mod / R	8	100	>0	Max Flight AVIA	75	-	-	75	20	2	Current AT is 15 min
P293	EG Type IV Expansion	1	IP / SN	8	100	>-5	Max Flight AVIA	75	25	-	-	10	1	No AT exists currently
P294	EG Type IV Expansion	1	IP-	8	100	-5 to -10	Max Flight AVIA	25	-	-	-	70	2	Current AT is 50 min
P295	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Max Flight AVIA	25	10	-	-	45	2	Current AT is 30 min
P296	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Max Flight AVIA	25	-	13	-	40	2	Current AT is 30 min
P297	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Max Flight AVIA	25	-	25	-	40	1	Current AT is 30 min
P298	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Max Flight AVIA	75	-	-	-	40	2	Current AT is 25 min
P299	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Max Flight AVIA	75	-	13	-	20	1	Current AT is 10 min
P300	EG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Max Flight AVIA	75	25	-	-	10	1	No AT exists currently
P301	EG Type IV Expansion	1	IP-	8	100	-10 to -16	Max Flight AVIA	25	-	-	-	50	1	Current AT is 30 min
P302	EG Type IV Expansion	1	IP- / SN-	8	100	-10 to -16	Max Flight AVIA	25	10	-	-	30	1	Current AT is 15 min
P303	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	Max Flight AVIA	75	-	-	-	25	1	Current AT is 10 min
P304	EG Type IV Expansion	1	IP-	8	100	-16 to -22	Max Flight AVIA	25	-	-	-	50	2	Current AT is 30 min
P305	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	Max Flight AVIA	25	10	-	-	15	1	No AT exists currently
P306	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	Max Flight AVIA	75	-	-	-	25	2	Current AT is 30 min
P307	EG Type IV Expansion	1	IP-	8	100	<-22	Max Flight AVIA	25	-	-	-	50	2	No AT exists currently
P308	EG Type IV Expansion	1	IP Mod	8	100	<-22	Max Flight AVIA	75	-	-	-	25	2	No AT exists currently
P309	EG Type IV Expansion	1	Fluid Only	8	100	>-5	Max Flight AVIA	-	-	-	-	-	2	Baseline Test
P310	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Max Flight AVIA	-	-	-	-	-	1	Baseline Test
P311	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Max Flight AVIA	-	-	-	-	-	2	Baseline Test
P312	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Max Flight AVIA	-	-	-	-	-	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/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	R Rate (g/dm²/h)	Exposure Time	Test Priority	COMMENT
P313	EG Type IV Expansion	1	Fluid Only	8	100	<-22	Max Flight AVIA	-	-	-	-	-	1	Baseline Test
P314	EG Type IV Expansion	1	IP-	8	100	>-5	Safewing EG IV NORTH	25	-	-	-	90	1	Current AT is 70 min
P315	EG Type IV Expansion	1	IP- / SN-	8	100	>-5	Safewing EG IV NORTH	25	10	-	-	60	1	Current AT is 50 min
P316	EG Type IV Expansion	1	IP- / ZD	8	100	>-5	Safewing EG IV NORTH	25	-	13	-	45	2	Current AT is 40 min
P317	EG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Safewing EG IV NORTH	25	-	25	-	45	1	Current AT is 40 min
P318	EG Type IV Expansion	1	IP- / R-	8	100	>0	Safewing EG IV NORTH	25	-	-	25	45	2	Current AT is 40 min
P319	EG Type IV Expansion	1	IP Mod	8	100	>-5	Safewing EG IV NORTH	75	-	-	-	45	1	Current AT is 35 min
P320	EG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Safewing EG IV NORTH	75	-	13	-	30	1	Current AT is 20 min
P321	EG Type IV Expansion	1	IP Mod / R	8	100	>0	Safewing EG IV NORTH	75	-	-	75	20	2	Current AT is 15 min
P322	EG Type IV Expansion	1	IP / SN	8	100	>-5	Safewing EG IV NORTH	75	25	-	-	10	1	No AT exists currently
P323	EG Type IV Expansion	1	IP-	8	100	-5 to -10	Safewing EG IV NORTH	25	-	-	-	70	2	Current AT is 50 min
P324	EG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Safewing EG IV NORTH	25	10	-	-	45	2	Current AT is 30 min
P325	EG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Safewing EG IV NORTH	25	-	13	-	40	2	Current AT is 30 min
P326	EG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Safewing EG IV NORTH	25	-	25	-	40	1	Current AT is 30 min
P327	EG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Safewing EG IV NORTH	75	-	-	-	40	2	Current AT is 25 min
P328	EG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Safewing EG IV NORTH	75	-	13	-	20	1	Current AT is 10 min
P329	EG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Safewing EG IV NORTH	75	25	-	-	10	1	No AT exists currently
P330	EG Type IV Expansion	1	IP-	8	100	-10 to -16	Safewing EG IV NORTH	25	-	-	-	50	1	Current AT is 30 min
P331	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
P332	EG Type IV Expansion	1	IP Mod	8	100	-10 to -16	Safewing EG IV NORTH	75	-	-	-	25	1	Current AT is 10 min
P333	EG Type IV Expansion	1	IP-	8	100	-16 to -22	Safewing EG IV NORTH	25	-	-	-	50	2	Current AT is 30 min
P334	EG Type IV Expansion	1	IP- / SN-	8	100	-16 to -22	Safewing EG IV NORTH	25	10	-	-	15	1	No AT exists currently
P335	EG Type IV Expansion	1	IP Mod	8	100	-16 to -22	Safewing EG IV NORTH	75	-	-	-	25	2	Current AT is 30 min
P336	EG Type IV Expansion	1	IP-	8	100	<-22	Safewing EG IV NORTH	25	-	-	-	50	2	No AT exists currently
P337	EG Type IV Expansion	1	IP Mod	8	100	<-22	Safewing EG IV NORTH	75	-	-	-	25	2	No AT exists currently
P338	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
P339	EG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P340	EG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Safewing EG IV NORTH	-	-	-	-	-	2	Baseline Test
P341	EG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P342	EG Type IV Expansion	1	Fluid Only	8	100	<-22	Safewing EG IV NORTH	-	-	-	-	-	1	Baseline Test
P343	PG Type IV Expansion	1	IP-	8	100	>-5	ClearWing ECO	25	-	-	-	60	1	60-70. Current AT is 50 min
P344	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	ClearWing ECO	25	10	-	-	50	1	Current AT is 40 min
P345	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	ClearWing ECO	25	-	13	-	30	2	30-40. Current AT is 25 min
P346	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	ClearWing ECO	25	-	25	-	30	1	30-40. Current AT is 25 min
P347	PG Type IV Expansion	1	IP- / R-	8	100	>0	ClearWing ECO	25	-	-	25	30	2	30-40. Current AT is 25 min
P348	PG Type IV Expansion	1	IP Mod	8	100	>-5	ClearWing ECO	75	-	-	-	25	1	25-35. Current AT is 15 min
P349	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	ClearWing ECO	75	-	13	-	15	1	15-20. Current AT is 10 min
P350	PG Type IV Expansion	1	IP Mod / R	8	100	>0	ClearWing ECO	75	-	-	75	15	2	Current AT is 10 min
P351	PG Type IV Expansion	1	IP / SN	8	100	>-5	ClearWing ECO	75	25	-	-	7	1	7-10. No AT exists currently
P352	PG Type IV Expansion	1	IP-	8	100	-5 to -10	ClearWing ECO	25	-	-	-	40	2	40-50. Current AT is 30 min
P353	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	ClearWing ECO	25	10	-	-	20	2	Current AT is 15 min
P354	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	ClearWing ECO	25	-	13	-	20	2	20-30. Current AT is 10 min
P355	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	ClearWing ECO	25	-	25	-	20	1	20-30. Current AT is 10 min
P356	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	ClearWing ECO	75	-	-	-	15	2	15-25. Current AT is 10 min
P357	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	ClearWing ECO	75	-	13	-	10	1	Current AT is 7 min
P358	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	ClearWing ECO	75	25	-	-	5	1	5-10. No AT exists currently
P359	PG Type IV Expansion	1	IP-	8	115	-10 to -16	ClearWing ECO	25	-	-	-	40	1	Current AT is 30 min
P360	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	ClearWing ECO	25	10	-	-	20	1	Current AT is 15 min
P361	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	ClearWing ECO	75	-	-	-	20	1	Current AT is 10 min
P362	PG Type IV Expansion	1	IP-	8	115	-16 to -22	ClearWing ECO	25	-	-	-	40	2	Current AT is 30 min
P363	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	ClearWing ECO	25	10	-	-	15	1	No AT exists currently

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
P364	PG Type IV Expansion	1	IP-	8	115	<-22	ClearWing ECO	25	-	-	-	40	2	No AT exists currently
P365	PG Type IV Expansion	1	Fluid Only	8	100	>-5	ClearWing ECO	-	-	-	-	-	2	Baseline Test
P366	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	ClearWing ECO	-	-	-	-	-	1	Baseline Test
P367	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	ClearWing ECO	-	-	-	-	-	2	Baseline Test
P368	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	ClearWing ECO	-	-	-	-	-	1	Baseline Test
P369	PG Type IV Expansion	1	Fluid Only	8	100	<-22	ClearWing ECO	-	-	-	-	-	1	Baseline Test
P370	PG Type IV Expansion	1	IP-	8	100	>-5	4Flite PG	25	-	-	-	60	1	60-70. Current AT is 50 min
P371	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	4Flite PG	25	10	-	-	50	1	Current AT is 40 min
P372	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	4Flite PG	25	-	13	-	30	2	30-40. Current AT is 25 min
P373	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	4Flite PG	25	-	25	-	30	1	30-40. Current AT is 25 min
P374	PG Type IV Expansion	1	IP- / R-	8	100	>0	4Flite PG	25	-	-	25	30	2	30-40. Current AT is 25 min
P375	PG Type IV Expansion	1	IP Mod	8	100	>-5	4Flite PG	75	-	-	-	25	1	25-35. Current AT is 15 min
P376	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	4Flite PG	75	-	13	-	15	1	15-20. Current AT is 10 min
P377	PG Type IV Expansion	1	IP Mod / R	8	100	>0	4Flite PG	75	-	-	75	15	2	Current AT is 10 min
P378	PG Type IV Expansion	1	IP / SN	8	100	>-5	4Flite PG	75	25	-	-	7	1	7-10. No AT exists currently
P379	PG Type IV Expansion	1	IP-	8	100	-5 to -10	4Flite PG	25	-	-	-	40	2	40-50. Current AT is 30 min
P380	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	4Flite PG	25	10	-	-	20	2	Current AT is 15 min
P381	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	4Flite PG	25	-	13	-	20	2	20-30. Current AT is 10 min
P382	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	4Flite PG	25	-	25	-	20	1	20-30. Current AT is 10 min
P383	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	4Flite PG	75	-	-	-	15	2	15-25. Current AT is 10 min
P384	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	4Flite PG	75	-	13	-	10	1	Current AT is 7 min
P385	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	4Flite PG	75	25	-	-	5	1	5-10. No AT exists currently
P386	PG Type IV Expansion	1	IP-	8	115	-10 to -16	4Flite PG	25	-	-	-	40	1	Current AT is 30 min
P387	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	4Flite PG	25	10	-	-	20	1	Current AT is 15 min
P388	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	4Flite PG	75	-	-	-	20	1	Current AT is 10 min

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
P389	PG Type IV Expansion	1	IP-	8	115	-16 to -22	4Flite PG	25	-	-	-	40	2	Current AT is 30 min
P390	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	4Flite PG	25	10	-	-	15	1	No AT exists currently
P391	PG Type IV Expansion	1	IP-	8	115	<-22	4Flite PG	25	-	-	-	40	2	No AT exists currently
P392	PG Type IV Expansion	1	Fluid Only	8	100	>-5	4Flite PG	-	-	-	-	-	2	Baseline Test
P393	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	4Flite PG	-	-	-	-	-	1	Baseline Test
P394	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	4Flite PG	-	-	-	-	-	2	Baseline Test
P395	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	4Flite PG	-	-	-	-	-	1	Baseline Test
P396	PG Type IV Expansion	1	Fluid Only	8	100	<-22	4Flite PG	-	-	-	-	-	1	Baseline Test
P397	PG Type IV Expansion	1	IP-	8	100	>-5	AVIAFlight PG	25	-	-	-	60	1	60-70. Current AT is 50 min
P398	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	AVIAFlight PG	25	10	-	-	50	1	Current AT is 40 min
P399	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	AVIAFlight PG	25	-	13	-	30	2	30-40. Current AT is 25 min
P400	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	AVIAFlight PG	25	-	25	-	30	1	30-40. Current AT is 25 min
P401	PG Type IV Expansion	1	IP- / R-	8	100	>0	AVIAFlight PG	25	-	-	25	30	2	30-40. Current AT is 25 min
P402	PG Type IV Expansion	1	IP Mod	8	100	>-5	AVIAFlight PG	75	-	-	-	25	1	25-35. Current AT is 15 min
P403	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	AVIAFlight PG	75	-	13	-	15	1	15-20. Current AT is 10 min
P404	PG Type IV Expansion	1	IP Mod / R	8	100	>0	AVIAFlight PG	75	-	-	75	15	2	Current AT is 10 min
P405	PG Type IV Expansion	1	IP / SN	8	100	>-5	AVIAFlight PG	75	25	-	-	7	1	7-10. No AT exists currently
P406	PG Type IV Expansion	1	IP-	8	100	-5 to -10	AVIAFlight PG	25	-	-	-	40	2	40-50. Current AT is 30 min
P407	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	AVIAFlight PG	25	10	-	-	20	2	Current AT is 15 min
P408	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	AVIAFlight PG	25	-	13	-	20	2	20-30. Current AT is 10 min
P409	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	AVIAFlight PG	25	-	25	-	20	1	20-30. Current AT is 10 min
P410	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	AVIAFlight PG	75	-	-	-	15	2	15-25. Current AT is 10 min
P411	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	AVIAFlight PG	75	-	13	-	10	1	Current AT is 7 min
P412	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	AVIAFlight PG	75	25	-	-	5	1	5-10. No AT exists currently
P413	PG Type IV Expansion	1	IP-	8	115	-10 to -16	AVIAFlight PG	25	-	-	-	40	1	Current AT is 30 min

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
P414	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	AVIAFlight PG	25	10	-	-	20	1	Current AT is 15 min
P415	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	AVIAFlight PG	75	-	-	-	20	1	Current AT is 10 min
P416	PG Type IV Expansion	1	IP-	8	115	-16 to -22	AVIAFlight PG	25	-	-	-	40	2	Current AT is 30 min
P417	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	AVIAFlight PG	25	10	-	-	15	1	No AT exists currently
P418	PG Type IV Expansion	1	IP-	8	115	<-22	AVIAFlight PG	25	-	-	-	40	2	No AT exists currently
P419	PG Type IV Expansion	1	Fluid Only	8	100	>-5	AVIAFlight PG	-	-	-	-	-	2	Baseline Test
P420	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P421	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	AVIAFlight PG	-	-	-	-	-	2	Baseline Test
P422	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P423	PG Type IV Expansion	1	Fluid Only	8	100	<-22	AVIAFlight PG	-	-	-	-	-	1	Baseline Test
P424	PG Type IV Expansion	1	IP-	8	100	>-5	Polar Guard® Xtend	25	-	-	-	60	1	60-70. Current AT is 50 min
P425	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	Polar Guard® Xtend	25	10	-	-	50	1	Current AT is 40 min
P426	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	Polar Guard® Xtend	25	-	13	-	30	2	30-40. Current AT is 25 min
P427	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Polar Guard® Xtend	25	-	25	-	30	1	30-40. Current AT is 25 min
P428	PG Type IV Expansion	1	IP- / R-	8	100	>0	Polar Guard® Xtend	25	-	-	25	30	2	30-40. Current AT is 25 min
P429	PG Type IV Expansion	1	IP Mod	8	100	>-5	Polar Guard® Xtend	75	-	-	-	25	1	25-35. Current AT is 15 min
P430	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Polar Guard® Xtend	75	-	13	-	15	1	15-20. Current AT is 10 min
P431	PG Type IV Expansion	1	IP Mod / R	8	100	>0	Polar Guard® Xtend	75	-	-	75	15	2	Current AT is 10 min
P432	PG Type IV Expansion	1	IP / SN	8	100	>-5	Polar Guard® Xtend	75	25	-	-	7	1	7-10. No AT exists currently
P433	PG Type IV Expansion	1	IP-	8	100	-5 to -10	Polar Guard® Xtend	25	-	-	-	40	2	40-50. Current AT is 30 min
P434	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Polar Guard® Xtend	25	10	-	-	20	2	Current AT is 15 min
P435	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Polar Guard® Xtend	25	-	13	-	20	2	20-30. Current AT is 10 min
P436	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Polar Guard® Xtend	25	-	25	-	20	1	20-30. Current AT is 10 min
P437	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Polar Guard® Xtend	75	-	-	-	15	2	15-25. Current AT is 10 min
P438	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Polar Guard® Xtend	75	-	13	-	10	1	Current AT is 7 min

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
P439	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Polar Guard® Xtend	75	25	-	-	5	1	5-10. No AT exists currently
P440	PG Type IV Expansion	1	IP-	8	115	-10 to -16	Polar Guard® Xtend	25	-	-	-	40	1	Current AT is 30 min
P441	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	Polar Guard® Xtend	25	10	-	-	20	1	Current AT is 15 min
P442	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	Polar Guard® Xtend	75	-	-	-	20	1	Current AT is 10 min
P443	PG Type IV Expansion	1	IP-	8	115	-16 to -22	Polar Guard® Xtend	25	-	-	-	40	2	Current AT is 30 min
P444	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	Polar Guard® Xtend	25	10	-	-	15	1	No AT exists currently
P445	PG Type IV Expansion	1	IP-	8	115	<-22	Polar Guard® Xtend	25	-	-	-	40	2	No AT exists currently
P446	PG Type IV Expansion	1	Fluid Only	8	100	>-5	Polar Guard® Xtend	-	-	-	-	-	2	Baseline Test
P447	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P448	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Polar Guard® Xtend	-	-	-	-	-	2	Baseline Test
P449	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P450	PG Type IV Expansion	1	Fluid Only	8	100	<-22	Polar Guard® Xtend	-	-	-	-	-	1	Baseline Test
P451	PG Type IV Expansion	1	IP-	8	100	>-5	Polar Guard® Advance	25	-	-	-	60	1	60-70. Current AT is 50 min
P452	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	Polar Guard® Advance	25	10	-	-	50	1	Current AT is 40 min
P453	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	Polar Guard® Advance	25	-	13	-	30	2	30-40. Current AT is 25 min
P454	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Polar Guard® Advance	25	-	25	-	30	1	30-40. Current AT is 25 min
P455	PG Type IV Expansion	1	IP- / R-	8	100	>0	Polar Guard® Advance	25	-	-	25	30	2	30-40. Current AT is 25 min
P456	PG Type IV Expansion	1	IP Mod	8	100	>-5	Polar Guard® Advance	75	-	-	-	25	1	25-35. Current AT is 15 min
P457	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Polar Guard® Advance	75	-	13	-	15	1	15-20. Current AT is 10 min
P458	PG Type IV Expansion	1	IP Mod / R	8	100	>0	Polar Guard® Advance	75	-	-	75	15	2	Current AT is 10 min
P459	PG Type IV Expansion	1	IP / SN	8	100	>-5	Polar Guard® Advance	75	25	-	-	7	1	7-10. No AT exists currently
P460	PG Type IV Expansion	1	IP-	8	100	-5 to -10	Polar Guard® Advance	25	-	-	-	40	2	40-50. Current AT is 30 min
P461	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Polar Guard® Advance	25	10	-	-	20	2	Current AT is 15 min
P462	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Polar Guard® Advance	25	-	13	-	20	2	20-30. Current AT is 10 min
P463	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Polar Guard® Advance	25	-	25	-	20	1	20-30. Current AT is 10 min

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
P464	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Polar Guard® Advance	75	-	-	-	15	2	15-25. Current AT is 10 min
P465	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Polar Guard® Advance	75	-	13	-	10	1	Current AT is 7 min
P466	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Polar Guard® Advance	75	25	-	-	5	1	5-10. No AT exists currently
P467	PG Type IV Expansion	1	IP-	8	115	-10 to -16	Polar Guard® Advance	25	-	-	-	40	1	Current AT is 30 min
P468	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	Polar Guard® Advance	25	10	-	-	20	1	Current AT is 15 min
P469	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	Polar Guard® Advance	75	-	-	-	20	1	Current AT is 10 min
P470	PG Type IV Expansion	1	IP-	8	115	-16 to -22	Polar Guard® Advance	25	-	-	-	40	2	Current AT is 30 min
P471	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	Polar Guard® Advance	25	10	-	-	15	1	No AT exists currently
P472	PG Type IV Expansion	1	IP-	8	115	<-22	Polar Guard® Advance	25	-	-	-	40	2	No AT exists currently
P473	PG Type IV Expansion	1	Fluid Only	8	100	>-5	Polar Guard® Advance	-	-	-	-	-	2	Baseline Test
P474	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Polar Guard® Advance	-	-	-	-	-	1	Baseline Test
P475	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Polar Guard® Advance	-	-	-	-	-	2	Baseline Test
P476	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Polar Guard® Advance	-	-	-	-	-	1	Baseline Test
P477	PG Type IV Expansion	1	Fluid Only	8	100	<-22	Polar Guard® Advance	-	-	-	-	-	1	Baseline Test
P478	PG Type IV Expansion	1	IP-	8	100	>-5	Defrost ECO 4	25	-	-	-	60	1	60-70. Current AT is 50 min
P479	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	Defrost ECO 4	25	10	-	-	50	1	Current AT is 40 min
P480	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	Defrost ECO 4	25	-	13	-	30	2	30-40. Current AT is 25 min
P481	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Defrost ECO 4	25	-	25	-	30	1	30-40. Current AT is 25 min
P482	PG Type IV Expansion	1	IP- / R-	8	100	>0	Defrost ECO 4	25	-	-	25	30	2	30-40. Current AT is 25 min
P483	PG Type IV Expansion	1	IP Mod	8	100	>-5	Defrost ECO 4	75	-	-	-	25	1	25-35. Current AT is 15 min
P484	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Defrost ECO 4	75	-	13	-	15	1	15-20. Current AT is 10 min
P485	PG Type IV Expansion	1	IP Mod / R	8	100	>0	Defrost ECO 4	75	-	-	75	15	2	Current AT is 10 min
P486	PG Type IV Expansion	1	IP / SN	8	100	>-5	Defrost ECO 4	75	25	-	-	7	1	7-10. No AT exists currently
P487	PG Type IV Expansion	1	IP-	8	100	-5 to -10	Defrost ECO 4	25	-	-	-	40	2	40-50. Current AT is 30 min
P488	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Defrost ECO 4	25	10	-	-	20	2	Current AT is 15 min

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
P489	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Defrost ECO 4	25	-	13	-	20	2	20-30. Current AT is 10 min
P490	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Defrost ECO 4	25	-	25	-	20	1	20-30. Current AT is 10 min
P491	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Defrost ECO 4	75	-	-	-	15	2	15-25. Current AT is 10 min
P492	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Defrost ECO 4	75	-	13	-	10	1	Current AT is 7 min
P493	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Defrost ECO 4	75	25	-	-	5	1	5-10. No AT exists currently
P494	PG Type IV Expansion	1	IP-	8	115	-10 to -16	Defrost ECO 4	25	-	-	-	40	1	Current AT is 30 min
P495	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	Defrost ECO 4	25	10	-	-	20	1	Current AT is 15 min
P496	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	Defrost ECO 4	75	-	-	-	20	1	Current AT is 10 min
P497	PG Type IV Expansion	1	IP-	8	115	-16 to -22	Defrost ECO 4	25	-	-	-	40	2	Current AT is 30 min
P498	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	Defrost ECO 4	25	10	-	-	15	1	No AT exists currently
P499	PG Type IV Expansion	1	IP-	8	115	<-22	Defrost ECO 4	25	-	-	-	40	2	No AT exists currently
P500	PG Type IV Expansion	1	Fluid Only	8	100	>-5	Defrost ECO 4	-	-	-	-	-	2	Baseline Test
P501	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Defrost ECO 4	-	-	-	-	-	1	Baseline Test
P502	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Defrost ECO 4	-	-	-	-	-	2	Baseline Test
P503	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Defrost ECO 4	-	-	-	-	-	1	Baseline Test
P504	PG Type IV Expansion	1	Fluid Only	8	100	<-22	Defrost ECO 4	-	-	-	-	-	1	Baseline Test
P505	PG Type IV Expansion	1	IP-	8	100	>-5	Max Flight SNEG	25	-	-	-	60	1	60-70. Current AT is 50 min
P506	PG Type IV Expansion	1	IP- / SN-	8	100	>-5	Max Flight SNEG	25	10	-	-	50	1	Current AT is 40 min
P507	PG Type IV Expansion	1	IP- / ZD	8	100	>-5	Max Flight SNEG	25	-	13	-	30	2	30-40. Current AT is 25 min
P508	PG Type IV Expansion	1	IP- / ZR-	8	100	>-5	Max Flight SNEG	25	-	25	-	30	1	30-40. Current AT is 25 min
P509	PG Type IV Expansion	1	IP- / R-	8	100	>0	Max Flight SNEG	25	-	-	25	30	2	30-40. Current AT is 25 min
P510	PG Type IV Expansion	1	IP Mod	8	100	>-5	Max Flight SNEG	75	-	-	-	25	1	25-35. Current AT is 15 min
P511	PG Type IV Expansion	1	IP Mod/ZD	8	100	>-5	Max Flight SNEG	75	-	13	-	15	1	15-20. Current AT is 10 min
P512	PG Type IV Expansion	1	IP Mod / R	8	100	>0	Max Flight SNEG	75	-	-	75	15	2	Current AT is 10 min
P513	PG Type IV Expansion	1	IP / SN	8	100	>-5	Max Flight SNEG	75	25	-	-	7	1	7-10. No AT exists currently

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
P514	PG Type IV Expansion	1	IP-	8	100	-5 to -10	Max Flight SNEG	25	-	-	-	40	2	40-50. Current AT is 30 min
P515	PG Type IV Expansion	1	IP- / SN-	8	100	-5 to -10	Max Flight SNEG	25	10	-	-	20	2	Current AT is 15 min
P516	PG Type IV Expansion	1	IP- / ZD	8	100	-5 to -10	Max Flight SNEG	25	-	13	-	20	2	20-30. Current AT is 10 min
P517	PG Type IV Expansion	1	IP- / ZR-	8	100	-5 to -10	Max Flight SNEG	25	-	25	-	20	1	20-30. Current AT is 10 min
P518	PG Type IV Expansion	1	IP Mod	8	100	-5 to -10	Max Flight SNEG	75	-	-	-	15	2	15-25. Current AT is 10 min
P519	PG Type IV Expansion	1	IP Mod/ZD	8	100	-5 to -10	Max Flight SNEG	75	-	13	-	10	1	Current AT is 7 min
P520	PG Type IV Expansion	1	IP / SN	8	100	-5 to -10	Max Flight SNEG	75	25	-	-	5	1	5-10. No AT exists currently
P521	PG Type IV Expansion	1	IP-	8	115	-10 to -16	Max Flight SNEG	25	-	-	-	40	1	Current AT is 30 min
P522	PG Type IV Expansion	1	IP- / SN-	8	115	-10 to -16	Max Flight SNEG	25	10	-	-	20	1	Current AT is 15 min
P523	PG Type IV Expansion	1	IP Mod	8	115	-10 to -16	Max Flight SNEG	75	-	-	-	20	1	Current AT is 10 min
P524	PG Type IV Expansion	1	IP-	8	115	-16 to -22	Max Flight SNEG	25	-	-	-	40	2	Current AT is 30 min
P525	PG Type IV Expansion	1	IP- / SN-	8	115	-16 to -22	Max Flight SNEG	25	10	-	-	15	1	No AT exists currently
P526	PG Type IV Expansion	1	IP-	8	115	<-22	Max Flight SNEG	25	-	-	-	40	2	No AT exists currently
P527	PG Type IV Expansion	1	Fluid Only	8	100	>-5	Max Flight SNEG	-	-	-	-	-	2	Baseline Test
P528	PG Type IV Expansion	1	Fluid Only	8	100	-5 to -10	Max Flight SNEG	-	-	-	-	-	1	Baseline Test
P529	PG Type IV Expansion	1	Fluid Only	8	100	-10 to -16	Max Flight SNEG	-	-	-	-	-	2	Baseline Test
P530	PG Type IV Expansion	1	Fluid Only	8	100	-16 to -22	Max Flight SNEG	-	-	-	-	-	1	Baseline Test
P531	PG Type IV Expansion	1	Fluid Only	8	100	<-22	Max Flight SNEG	-	-	-	-	-	1	Baseline Test
P532	Type III LS Allowance Times	2	IP-	8	80	>-5	Type III Fluid	25	-	-	-	10	1	
P533	Type III LS Allowance Times	2	IP- / SN-	8	80	>-5	Type III Fluid	25	10	-	-	10	1	
P534	Type III LS Allowance Times	2	IP- / ZD	8	100	>-5	Type III Fluid	25	-	13	-	7	1	
P535	Type III LS Allowance Times	2	IP- / ZR-	8	80	>-5	Type III Fluid	25	-	25	-	7	1	
P536	Type III LS Allowance Times	2	IP- / R-	8	80	>0	Type III Fluid	25	-	-	25	7	2	
P537	Type III LS Allowance Times	2	IP Mod	8	80	>-5	Type III Fluid	75	-	-	-	5	1	
P538	Type III LS Allowance Times	2	IP-	8	80	-5 to -10	Type III Fluid	25	-	-	-	10	1	
P539	Type III LS Allowance Times	2	IP- / SN-	8	80	-5 to -10	Type III Fluid	25	10	-	-	10	1	

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
P540	Type III LS Allowance Times	2	IP- / ZD	8	100	-5 to -10	Type III Fluid	25	-	13	-	5	1	
P541	Type III LS Allowance Times	2	IP- / ZR-	8	80	-5 to -10	Type III Fluid	25	-	25	-	5	1	
P542	Type III LS Allowance Times	2	IP Mod	8	80	-5 to -10	Type III Fluid	75	-	-	-	5	1	
P543	Type III LS Allowance Times	2	IP-	8	80	-10 to -16	Type III Fluid	25	-	-	-	10	2	
P544	Type III LS Allowance Times	2	IP Mod	8	80	-10 to -16	Type III Fluid	75	-	-	-	5	2	
P545	Type III LS Allowance Times	2	IP-	8	80	-16 to -22	Type III Fluid	25	-	-	-	10	2	
P546	Type III LS Allowance Times	2	IP Mod	8	80	-16 to -22	Type III Fluid	75	-	-	-	5	2	
P547	Type III LS Allowance Times	2	IP-	8	80	<-22	Type III Fluid	25	-	-	-	10	2	
P548	Type III LS Allowance Times	2	IP Mod	8	80	<-22	Type III Fluid	75	-	-	-	5	2	
P549	Type III LS Allowance Times	2	Fluid Only	8	80	-5 to -10	Type III Fluid	-	-	-	-	-	1	Baseline Test
P550	Type III LS Allowance Times	2	Fluid Only	8	80	-16 to -22	Type III Fluid	-	-	-	-	-	1	Baseline Test
P551	Type III LS Allowance Times	2	IP-	8	100	>-5	Type III Fluid	25	-	-	-	10	1	To be done with RJ wing
P552	Type III LS Allowance Times	2	IP-	8	100	-5 to -10	Type III Fluid	25	-	-	-	10	1	To be done with RJ wing
P553	Type III LS Allowance Times	2	IP-	8	100	-10 to -16	Type III Fluid	25	-	-	-	10	2	To be done with RJ wing
P554	Type III LS Allowance Times	2	Fluid Only	8	100	-5 to -10	Type III Fluid	-	-	-	-	-	1	To be done with RJ wing
P555	Type III LS Allowance Times	2	Fluid Only	8	100	-16 to -22	Type III Fluid	-	-	-	-	-	1	To be done with RJ wing
P556	Type III HS Expansion	3	IP-	8	100	>-5	Type III Fluid	25	-	-	-	20	1	Current AT x2. To Revisit
P557	Type III HS Expansion	3	IP- / SN-	8	100	>-5	Type III Fluid	25	10	-	-	20	1	Current AT x2. To Revisit
P558	Type III HS Expansion	3	IP- / ZD	8	100	>-5	Type III Fluid	25	-	13	-	14	1	Current AT x2. To Revisit
P559	Type III HS Expansion	3	IP- / ZR-	8	100	>-5	Type III Fluid	25	-	25	-	14	1	Current AT x2. To Revisit
P560	Type III HS Expansion	3	IP- / R-	8	100	>0	Type III Fluid	25	-	-	25	14	2	Current AT x2. To Revisit
P561	Type III HS Expansion	3	IP Mod	8	100	>-5	Type III Fluid	75	-	-	-	10	1	Current AT x2. To Revisit
P562	Type III HS Expansion	3	IP-	8	100	-5 to -10	Type III Fluid	25	-	-	-	20	1	Current AT x2. To Revisit
P563	Type III HS Expansion	3	IP- / SN-	8	100	-5 to -10	Type III Fluid	25	10	-	-	20	1	Current AT x2. To Revisit
P564	Type III HS Expansion	3	IP- / ZD	8	100	-5 to -10	Type III Fluid	25	-	13	-	10	1	Current AT x2. To Revisit
P565	Type III HS Expansion	3	IP- / ZR-	8	100	-5 to -10	Type III Fluid	25	-	25	-	10	1	Current AT x2. To Revisit

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
P566	Type III HS Expansion	3	IP Mod	8	100	-5 to -10	Type III Fluid	75	-	-	-	10	1	Current AT x2. To Revisit
P567	Type III HS Expansion	3	IP-	8	100	-10 to -16	Type III Fluid	25	-	-	-	20	2	Expected AT x2. No AT exists
P568	Type III HS Expansion	3	IP Mod	8	100	-10 to -16	Type III Fluid	75	-	-	-	10	2	Expected AT x2. No AT exists
P569	Type III HS Expansion	3	IP-	8	100	-16 to -22	Type III Fluid	25	-	-	-	20	2	Expected AT x2. No AT exists
P570	Type III HS Expansion	3	IP Mod	8	100	-16 to -22	Type III Fluid	75	-	-	-	10	2	Expected AT x2. No AT exists
P571	Type III HS Expansion	3	IP-	8	100	<-22	Type III Fluid	25	-	-	-	20	2	Expected AT x2. No AT exists
P572	Type III HS Expansion	3	IP Mod	8	100	<-22	Type III Fluid	75	-	-	-	10	2	Expected AT x2. No AT exists
P573	Type III HS Expansion	3	Fluid Only	8	100	-5 to -10	Type III Fluid	-	-	-	-	-	1	Baseline Test, needed for LS
P574	Type III HS Expansion	3	Fluid Only	8	100	-16 to -22	Type III Fluid	-	-	-	-	-	1	Baseline Test, needed for LS
P575	R&D	2	METAR	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Snow Allowance Times
P576	R&D	3	S+++	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Heavy snow
P577	R&D	3	Heavy Cont	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Heavy contamination
P578	R&D	3	LOUT w/ Cont.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	3	Test w/ contamination @ LOUT

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 2021-22 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.

A rating system based on aerodynamic and visual observation data 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 adequately shed the fluid at time of rotation) shall be determined by the on-site experts based on residual contamination.

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.

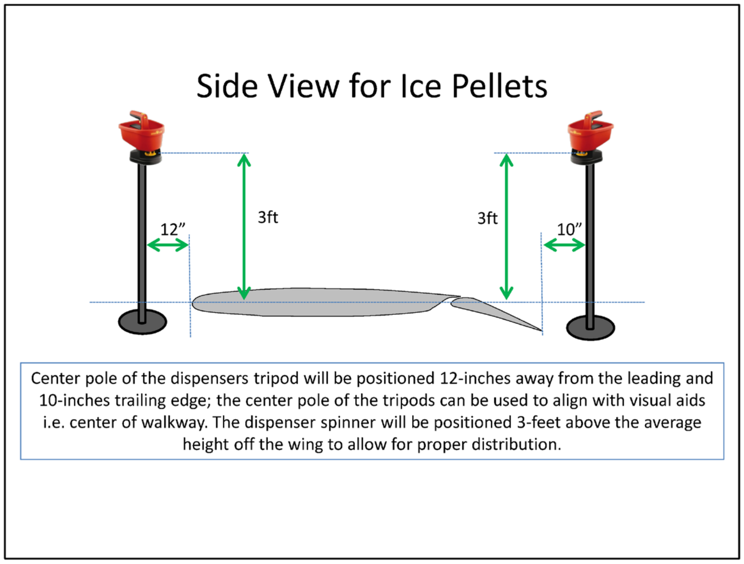

Figure 6.1: Side View of Positioning of Dispensers Relative to the Wing – Ice Pellets

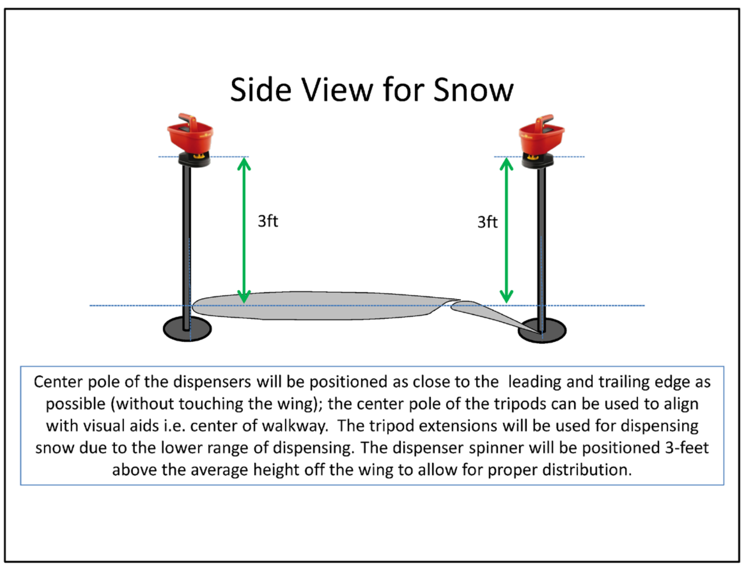

Figure 6.2: Side View of Positioning of Dispenser Relative to the Wing – Snow

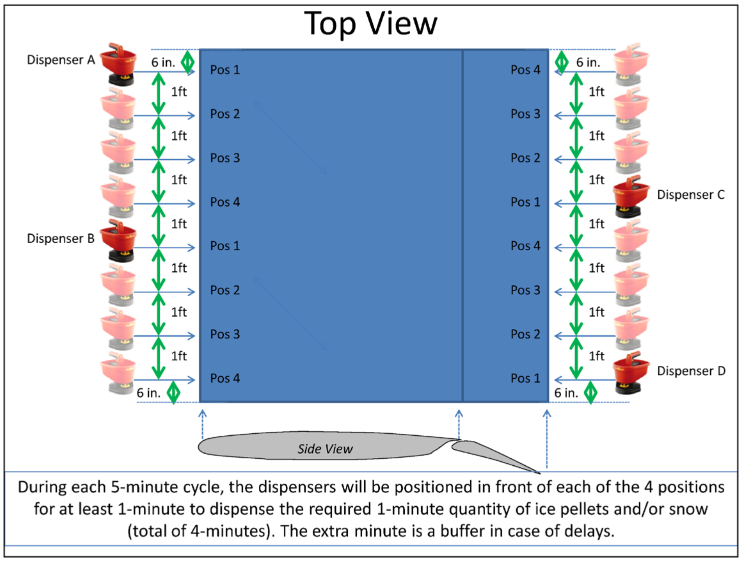

Figure 6.3: Top View of Positioning of Dispenser Relative to the Wing

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

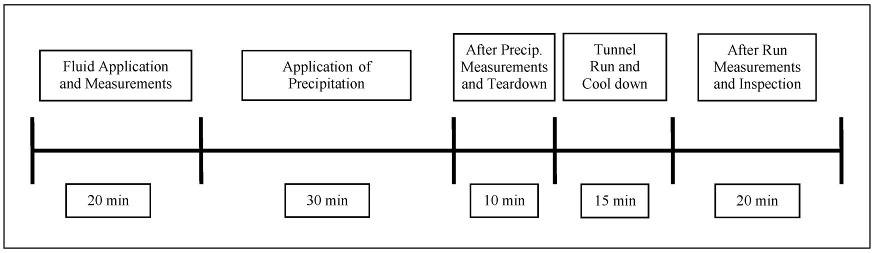

Figure 6.4: Typical Wind Tunnel Run Timeline

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 – General Allowance Time Expansion;
- Attachment 14: Procedure – METAR Working Group Identified Conditions;
- Attachment 15: Procedure – Type III Ice Pellet Allowance Time Table Expansion and Development of a Low Speed Table;
- Attachment 16: Procedure – Heavy Snow;
- Attachment 17: Procedure – Heavy Contamination; and
- Attachment 18: Procedure – Fluid and Contamination at LOUT.

7. EQUIPMENT

Equipment to be employed is shown in Table 7.1. Note that crossed off items will not be required for the 2021-22 testing season but have been left in the list for continuity.

Table 7.1: Equipment List

~~EQUIPMENT~~	STATUS		EQUIPMENT	STATUS
~~General Support and Testing Equipment~~			Camera Equipment	
~~20L clean containers (if expecting totes)~~			DSLR cameras x3 + lenses etc. (2 suitcases)	
~~Backpack sprayer for Fluids x3~~			Godox flashes x2	
~~Barrel Opener (if expecting barrels)~~			Manfroto arms and mounts suitcase	
~~Black Shelving Unit for rate pans (or plastic)~~			Osmo/GoPro Cameras + accessories	
~~Blow Horns x 2~~			Remote camera system (See SM for details)	
~~Blue Protective Face Masks x 300+~~			Camera laptop with mouse and chargers	
~~Brixometer x 3~~				
~~Electrical tape x 2~~			Ice Pellets Fabrication Equipment	
~~Exacto Knives x 2~~			Adherence Probes Kit	
~~Extension cords (power bars x 6 + reels x 4)~~			Blenders x 12 in good condition	
~~Eye protection x 10~~			Folding tables (2 large, 1 small)	
~~Falling Ball Viscometer~~			Ice bags	
~~Fluid pouring pitchers x100 (confirm amt?)~~			Ice bags storage freezer x 3	
~~Fluids (ORDER and SHIP to Ottawa)~~			Ice pellet box supports for railing x4	
~~Fridge for personnel x1~~			Ice Pellet control wires and boxes	
~~Funnels (1 big + 1 small)~~			Ice pellets dispersers x 12	
~~Gloves - black and yellow~~			Sieves (solid base, 1.4 mm, 4 mm) x 2 each	
~~Gloves - cotton (a lot)~~			Stands for ice pellets dispensing devices x 6	
~~Gloves - latex (a lot)~~			Ice pellets Styrofoam containers x40	
~~Grid Section + Location docs~~			Measuring cups (1L + 1cup/smaller)	
~~Hard water chemicals x 3 premixes~~			Sartorius 35KG scale	
~~Hand Sanitizer (x3 larger jugs/dispensers)~~			Refrigerated Truck	
~~Horse and tap for fluid barrel x all~~			Rubber Mats x 4	
~~Hot Plate x 3 and Large Pots for Type I~~			Wooden Spoons	
~~Inclinometer (yellow level) x 2~~				
~~Isopropyl x 12~~			Freezing Rain Equipment	
~~Large and small tape measure~~			APS PC equipped with rate station software	
~~Large Sharpies for Grid Section~~			NRC Freezing rain sprayer (NRC provided)	
~~Long Ruler for marking wing x 2~~			Rubber suction feet for wooden boards x8	
~~Marker for waste x 2~~			White plastic rate pans (4 sets)	
~~Paper towel (blue shop towel) x 48~~			Wooden boards for rate pans (x2)	
~~Protective yellow rubber clothing (all)~~				
~~Personal Clothing for APS YUL team~~			Office Equipment	
~~Red Thermoses for Type III Transport~~			APS Laptops x 4 with mouse and chargers	
~~Sample bottles for viscosity (x6)~~			APS tuques x 10	
~~Sartorius Weigh Scale x 1~~			Calculators x 3	
~~Scrapers x 5~~			Clip boards x 8	
~~Shop Vac~~			Data Forms	
~~Speed tape x 1 small~~			Dry eraser markers	
~~Squeegees (5 small + 3 large floor)~~			Envelopes (9x12) x box	
~~Stop Watches x 4~~			File box x 2	
~~Temperature probes: immersion x 3~~			Hard drive with all WT Photos	
~~Temperature probes: surface x 3~~			New blank SSD Hard Drives x 2	
~~Test Plate x 1~~			Pencils + sharpies/markers	
~~Thermometer for Reefer Truck~~			Projector for laptop	
~~Thickness Gauges (5 small, 5 big)~~			Scissors	
~~Vise grip + rubber opener for containers~~			Small 90° aluminum ruler for wing	
~~Walkie Talkies x 12~~			Test Procedures x 4, printer paper	
~~Water (2 x 18L) for hard water~~			YOW employee contracts	
~~Whatmans Paper and conversion charts~~				
			V-Stab Gear	
			Motorized backpack sprayer for Fluids/ZR x3	
			Calibration pans and stand (if needed)	
			Step ladders (use NRC's and buy if needed)	

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 EG and 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). Approximately 4540 L of fluid will be available for the 2021-22 testing session. 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)
Existing Fluid Inventory						
ClearWing EG	IV	EG	100/0	TAB20-CW1207	80	
Defrost ECO 4	IV	PG	100/0	4 (LOT #48)	120	
EG106 (new batch)	IV	EG	100/0	D268KAG000	60	
Max Flight AVIA	IV	EG	100/0	41	60	
Max Flight SNEG	IV	PG	100/0	8	200	
Polar Guard Advance	IV	PG	100/0	PGA181205PA	60	
Safewing EG IV NORTH	IV	EG	100/0	01819	100	
AeroClear MAX	III	EG	100/0	TAB17-1023	160	
Fluid Ordered						
ClearWing ECO	IV	PG	100/0	tbd:	-	400
ClearWing EG	IV	EG	100/0	tbd:	-	400
4Flite EG	IV	EG	100/0	tbd:	-	n/a
4Flite PG	IV	PG	100/0	tbd:	-	n/a
AVIAFlight EG	IV	EG	100/0	tbd:	-	n/a
AVIAFlight PG	IV	PG	100/0	tbd:	-	n/a
ChemR Nordik IV	IV	EG	100/0	tbd:	-	500
Polar Guard® Xtend	IV	PG	100/0	tbd:	-	400
Polar Guard® Advance	IV	PG	100/0	tbd:	-	400
UCAR™ Endurance EG106 De/Anti-Icing Fluid	IV	EG	100/0	tbd:	-	600
UCAR™ PG ADF Concentrate	IV	PG	100/0	tbd:	-	200
Defrost NORTH 4	IV	EG	100/0	tbd:	-	500
FCY-EGIV	IV	EG	100/0	tbd:	-	300

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)
2480L available for 2020-21 Testing (15 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 (participating remotely)
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	
Photo 1	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 or will be limited and will be encouraged to participate via teleworking measures.

NRC Aerospace Research Centre Contacts

- Catherine Clark: (613) 990-6796; and
- Cory Bates: (613) 913-9720.

10. SAFETY

- A safety briefing will be done on the first day of testing;
- COVID-19 mitigation procedures will be in place;
- 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;
- If fluid comes into contact with eyes, flush with the portable eye wash station; and
- Personnel must ensure they follow the protocols for working extended hours.

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

Personnel must follow the protocols for “Extended Work Hours Protocol for APS Personnel.” These documents are included in the “APS Office Policies & Procedures” which is made available to all APS staff.

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/dm²/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/dm²/h): ____________ Droplet Size (mm): ____________

Exposure Time: ____________ Needle: ____________

Flow: ____________

Pressure ____________

SNOW APPLICATION (if applicable)

Actual start time: ____________ Actual End Time: ____________

Rate of Snow Applied (g/dm²/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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Final Version 1.0/Wind Tunnel 2021-22 Final Version 1.0.docx
Final Version 1.0, December 21

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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:				

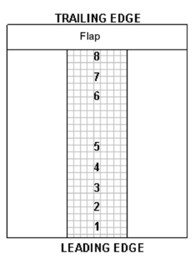
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2			
8			
Flap			
Time:			

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

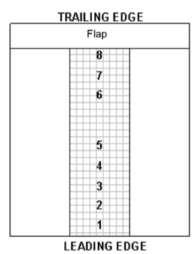
1	2	3	4	hold	time
☐	☐	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: __________

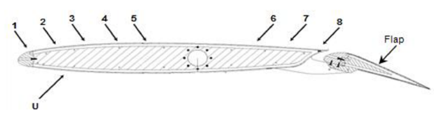


Comments:____________________

Wing and Plate Condition
After the Takeoff Run
Time: __________



Comments:____________________



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: ____________________

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/dm²/h**
Duration	**5**	**minutes**

Footprint Rate	25	g/dm²/h
Stdev of Rate (+/-)	5	g/dm²/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 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...)

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.

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/dm^2/h**
Duration	**5**	**minutes**

Footprint Rate	25	g/dm^2/h
Stdev of Rate	10	g/dm^2/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:__________________________

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)

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

Eight 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. A new separate allowance time table for EG fluids was issued for the winter of 2021-22 based on the best available data collected to date which included the expansion data, however the expansion data was limited to temperatures above -10°C. In addition, some of the targeted newly expanded times still showed potential for further expansion.

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. Focus should be on conditions below -10°C and any recently expanded conditions that still have potential for further expansion;
- 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

4 days of testing are planned.

Attachment 13: Procedure – General Allowance Time Expansion

Background

Over the years, the ice pellet allowance times have been expanded to include additional conditions, temperature ranges, and fluid types. The current tables are a reflection of the conditions whereby sufficient data was collected to substantiate the guidance provided to operators. There are still conditions where data is either limited or not available that could be suitable areas for development of new guidance material to expand the operational envelope. In addition, new generation fluids may have better performance capabilities and may justify an extension to existing times.

Objective

To conduct testing to support the general expansion of the ice pellet allowance time guidance material to include additional conditions, temperature ranges, and fluid types

Methodology

- Review historical data to determine which conditions, temperature ranges, and fluid types to target as potential candidates for expansion;
- Conduct testing with commercially available Type IV fluids in each of the cells of the ice pellet allowance times table, as required;
- Consider testing with Type II fluids to target the development of a standalone table;
- Record lift data, visual observations, and manually collected data; and
- Adjust testing plan accordingly based on aerodynamic data collected.

Test Plan

Three days of testing are planned.

Attachment 14: Procedure – METAR Working Group Identified Conditions

Background

A METAR working group consisting of TC, FAA, APS, NCAR has been formed with the objective of improving the guidance available for operations in mixed conditions. Of the conditions being analyzed, some of these conditions are combinations including ice pellets and can sometimes contain three or more precipitation types at a time. Aerodynamic data could support the development of guidance material for these specific conditions.

Objective

To conduct testing to support the METAR working group activities related to mixed conditions and with ice pellets.

Methodology

- Identify mixed conditions for testing i.e. -SN/-IP/-ZR;
- Conduct testing with commercially available Type IV fluids in the representative temperatures;
- Record lift data, visual observations, and manually collected data; and
- Adjust testing plan accordingly based on aerodynamic data collected.

Test Plan

Ten or more tests would provide a suitable dataset for analysis.

Attachment 15: Procedure – Type III Ice Pellet Allowance Time Table Expansion and Development of a Low Speed Table

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 and development of a low speed table.

Methodology

- Conduct testing with commercially available Type III fluids in each of the cells of the ice pellet allowance times table at 80 knots or 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 16: 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 17: 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 18: 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.

APPENDIX C

HIGH SPEED TESTING 2021-22 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 9, 2022 Run: 3 (P112)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.0	-4.4	-11.2	-6.5
T5	-4.9	-4.6	-9.6	-6.0
TU	-4.8	-4.0	-5.4	-6.2
Time:	21:59	22:13	22:28	22:44

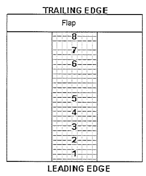
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	28.5	28.5
8	/	28.75	32.0
Flap	/	19.5	30.0
Time:	22:13	22:30	22:45

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	158	11
3			
4			
5	200	250	14
6			
7			
8	134	150	12
Flap	45	24	10
Time:	22:13	22:30	22:46

CYCLE TRACKING

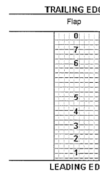
time	1	2	3	4	hold
5 mins	☑	☑	☑	☑	☑
10 mins	☑	☑	☑	☐	☐
15 mins	☐	☐	☐	☐	☐
20 mins	☐	☐	☐	☐	☐
25 mins	☐	☐	☐	☐	☐
30 mins	☐	☐	☐	☐	☐
35 mins	☐	☐	☐	☐	☐
40 mins	☐	☐	☐	☐	☐
45 mins	☐	☐	☐	☐	☐
50 mins	☐	☐	☐	☐	☐
55 mins	☐	☐	☐	☐	☐
60 mins	☐	☐	☐	☐	☐
65 mins	☐	☐	☐	☐	☐
70 mins	☐	☐	☐	☐	☐
75 mins	☐	☐	☐	☐	☐
80 mins	☐	☐	☐	☐	☐
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: ____________

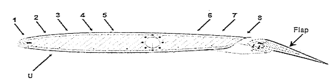


Comments:

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C3: Run # 3

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 9, 2022 Run: 4 (P107)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.8	-6.0	-10.2	-9.0
T5	-6.5	-5.9	-8.8	-8.5
TU	-6.4	-4.9	-6.9	-7.9
Time:	23:01	23:11	00:05	00:15

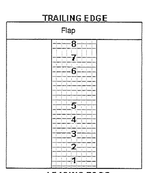
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	21.75	25.0
8	/	22.5	31.0
Flap	/	17.0	30.0
Time:	23:11	00:06	00:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	142	150	9
3			
4			
5	200	250	8
6			
7			
8	150	158	12
Flap	56	6	7
Time:	23:11	00:07	00:18

CYCLE TRACKING

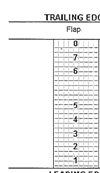
time	1	2	3	4	hold
5 mins	☑	☑	☑	☑	☑
10 mins	☑	☑	☑	☑	☑
15 mins	☑	☑	☑	☑	☑
20 mins	☑	☑	☑	☑	☑
25 mins	☑	☑	☑	☑	☑
30 mins	☑	☑	☑	☑	☑
35 mins	☑	☑	☑	☑	☑
40 mins	☑	☑	☑	☑	☑
45 mins	☑	☑	☑	☑	☑
50 mins	☑	☑	☑	☑	☑
55 mins	☐	☐	☐	☐	☐
60 mins	☐	☐	☐	☐	☐
65 mins	☐	☐	☐	☐	☐
70 mins	☐	☐	☐	☐	☐
75 mins	☐	☐	☐	☐	☐
80 mins	☐	☐	☐	☐	☐
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: ____________

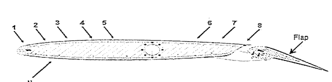


Comments:

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.

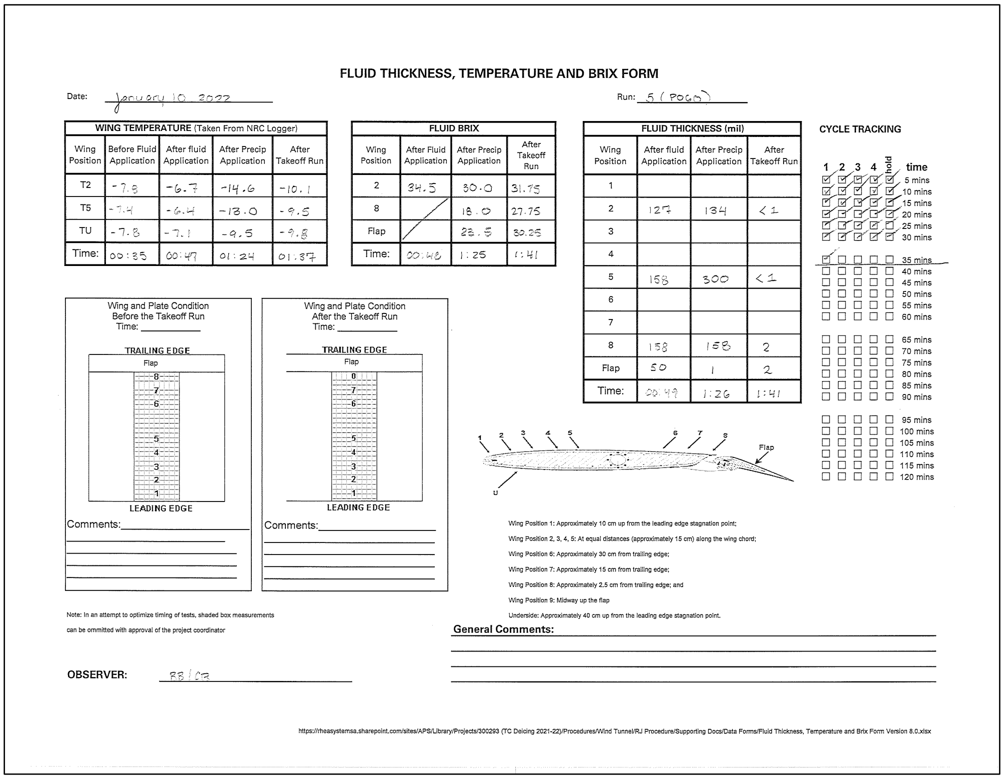
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C4: Run # 4



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10 2022 Run: 5 (POGO)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.8	-6.7	-14.6	-10.1
T5	-7.4	-6.4	-13.0	-9.5
TU	-7.8	-7.1	-9.5	-9.8
Time:	00:35	00:47	01:24	01:37

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	30.0	31.75
8	/	18.0	27.75
Flap	/	23.5	30.25
Time:	00:48	1:25	1:41

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	134	<1
3			
4			
5	158	300	<1
6			
7			
8	158	158	2
Flap	50	1	2
Time:	00:49	1:26	1:41

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ____ TRAILING EDGE Flap LEADING EDGE Comments:

Wing and Plate Condition After the Takeoff Run Time: ____ TRAILING EDGE Flap 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.

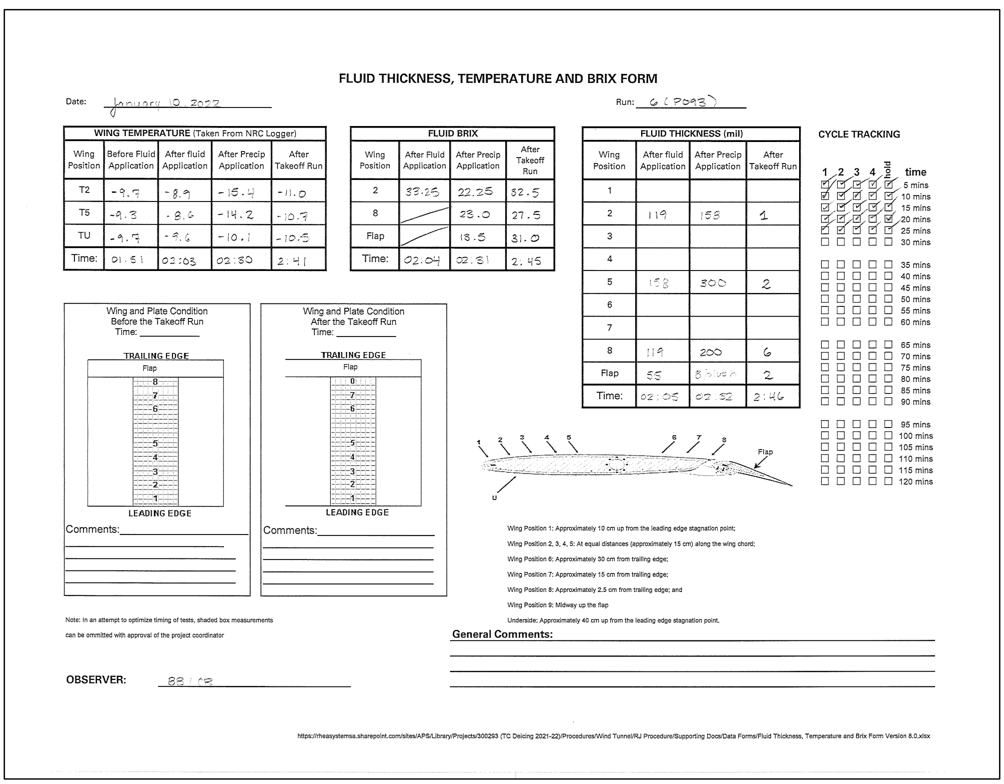
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C5: Run # 5



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10 2022 Run: 6 (P093)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.7	-8.9	-15.4	-11.0
T5	-9.3	-8.6	-14.2	-10.7
TU	-9.7	-9.6	-10.1	-10.5
Time:	01:51	02:03	02:30	2:41

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	22.25	32.5
8	/	23.0	27.5
Flap	/	13.5	31.0
Time:	02:04	02:31	2:45

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	1
3			
4			
5	158	300	2
6			
7			
8	119	200	6
Flap	55	8 slush	2
Time:	02:05	02:32	2:46

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ____ TRAILING EDGE Flap LEADING EDGE Comments:

Wing and Plate Condition After the Takeoff Run Time: ____ TRAILING EDGE Flap 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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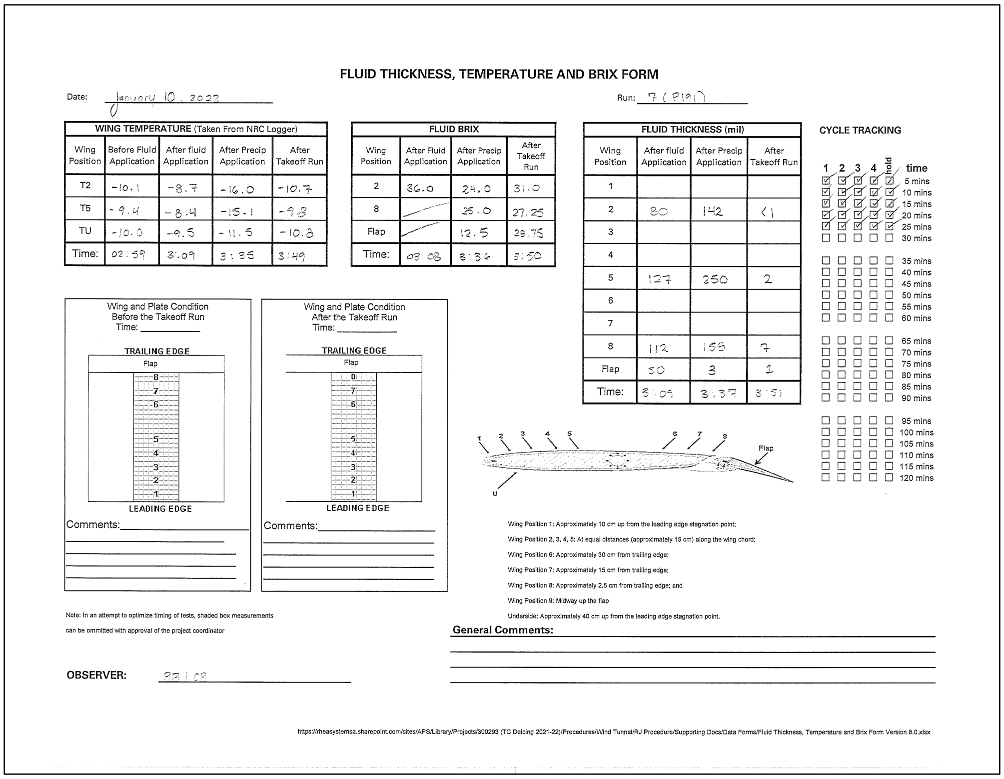
Figure C6: Run # 6



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10, 2022 Run: 7 (P191)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.1	-8.7	-16.0	-10.7
T5	-9.4	-8.4	-15.1	-9.8
TU	-10.0	-9.5	-11.5	-10.8
Time:	02:59	3:09	3:35	3:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	24.0	31.0
8		25.0	27.25
Flap		12.5	28.75
Time:	03:08	3:36	3:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	142	<1
3			
4			
5	127	250	2
6			
7			
8	112	156	7
Flap	30	3	1
Time:	3:09	3:37	3:51

CYCLE TRACKING (1, 2, 3, 4, hold; time 5 mins – 120 mins): 5, 10, 15, 20, 25 mins checked

Wing and Plate Condition Before the Takeoff Run Time:
Wing and Plate Condition After the Takeoff Run Time:
TRAILING EDGE / Flap / 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: RB / CR

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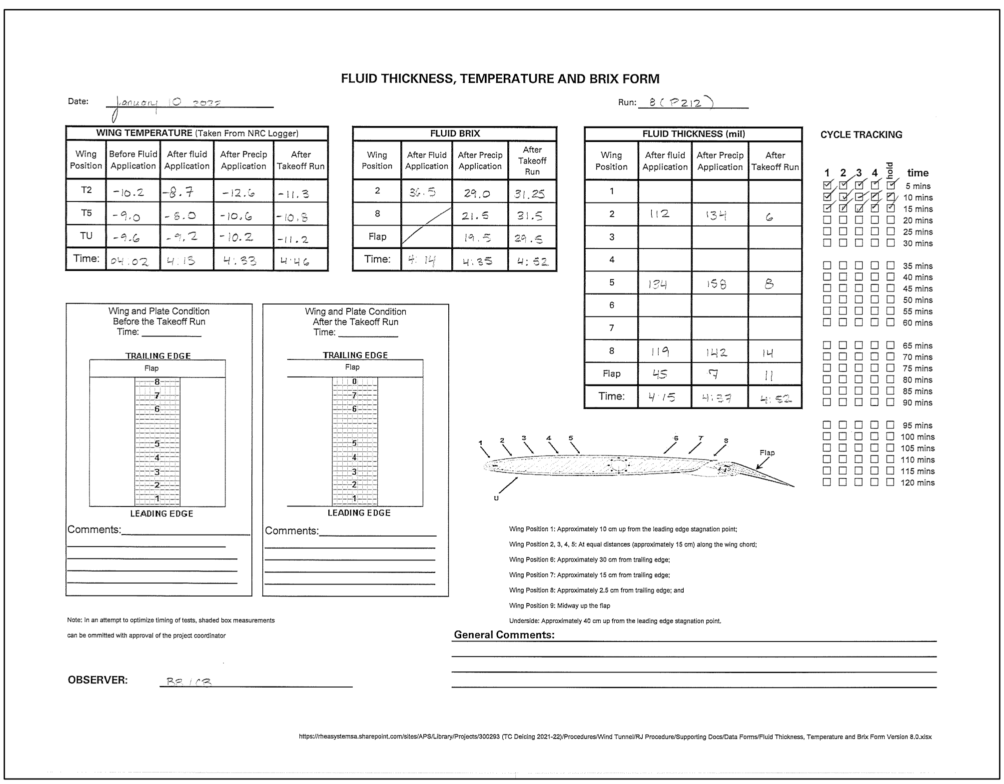
Figure C7: Run # 7



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10, 2022 Run: 8 (P212)

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	-12.6	-11.3
T5	-9.0	-8.0	-10.6	-10.8
TU	-9.6	-9.2	-10.2	-11.2
Time:	04:02	4:13	4:33	4:46

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	29.0	31.25
8		21.5	31.5
Flap		19.5	29.5
Time:	4:14	4:35	4:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	134	6
3			
4			
5	134	158	8
6			
7			
8	119	142	14
Flap	45	7	11
Time:	4:15	4:37	4:52

CYCLE TRACKING (1, 2, 3, 4, hold; time 5 mins – 120 mins): 5, 10, 15 mins checked

Wing and Plate Condition Before the Takeoff Run Time:
Wing and Plate Condition After the Takeoff Run Time:
TRAILING EDGE / Flap / 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: RB / CR

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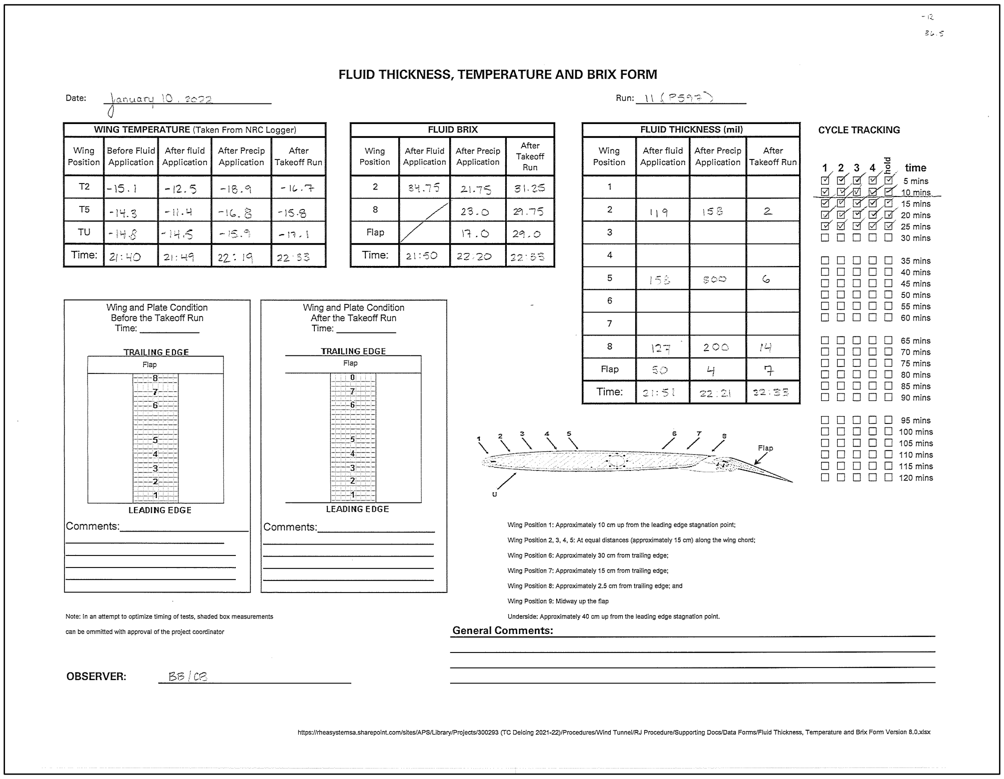
Figure C8: Run # 8

No Data Available

Figure C9: Run # 9

No Data Available

Figure C10: Run # 10



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10, 2022 Run: 11 (P597)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.1	-12.5	-18.9	-16.7
T5	-14.3	-11.4	-16.8	-15.8
TU	-14.8	-14.5	-15.9	-17.1
Time:	21:40	21:49	22:19	22:33

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	21.75	31.25
8	/	23.0	29.75
Flap	/	17.0	29.0
Time:	21:50	22:20	22:33

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	2
3			
4			
5	158	300	6
6			
7			
8	127	200	14
Flap	50	4	7
Time:	21:51	22:21	22:33

CYCLE TRACKING

1 2 3 4 hold time: 5 mins – 120 mins

Wing and Plate Condition Before the Takeoff Run Time:

Wing and Plate Condition After the Takeoff Run Time:

TRAILING EDGE / Flap / 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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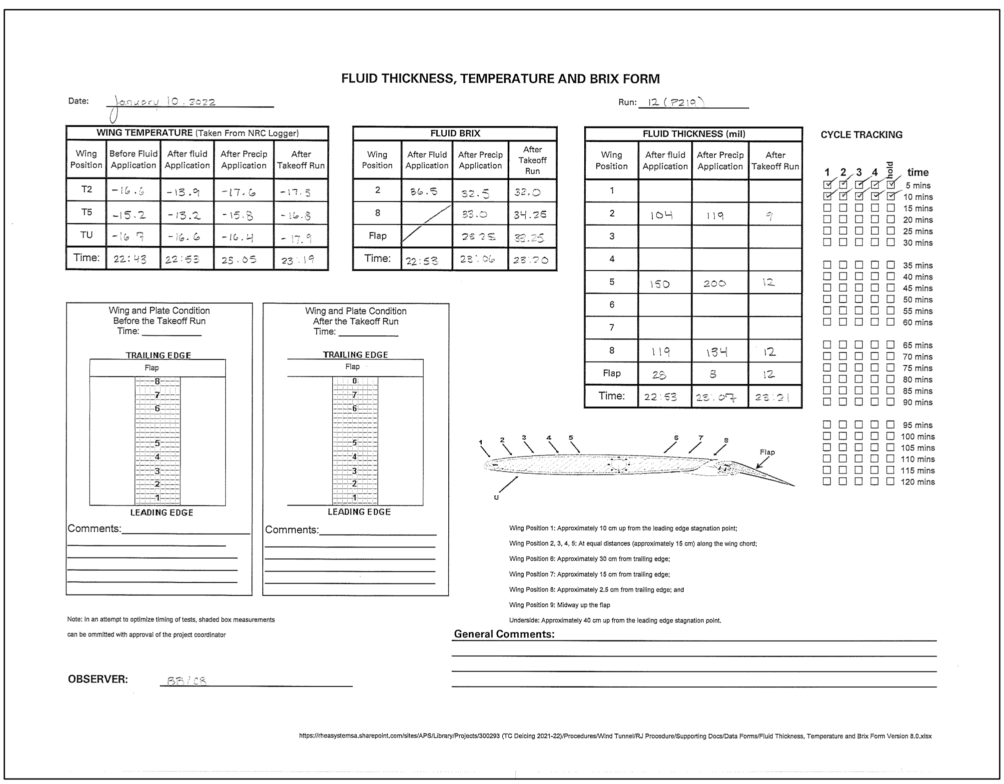
Figure C11: Run # 11



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 10, 2022 Run: 12 (P219)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.6	-13.9	-17.6	-17.3
T5	-15.2	-13.2	-15.8	-16.8
TU	-16.7	-16.6	-16.4	-17.9
Time:	22:43	22:53	23.05	23:19

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	32.5	32.0
8	/	33.0	34.25
Flap	/	28.25	33.25
Time:	22:53	23:06	23:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	119	9
3			
4			
5	150	200	12
6			
7			
8	119	134	12
Flap	28	8	12
Time:	22:53	23:07	23:21

CYCLE TRACKING

1 2 3 4 hold time: 5 mins – 120 mins

Wing and Plate Condition Before the Takeoff Run Time:

Wing and Plate Condition After the Takeoff Run Time:

TRAILING EDGE / Flap / 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 C12: Run # 12

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11 2021 Run: 13 (P217)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-17.7	-13.9	-16.5	-19.1
T5	-17.1	-17.9	-15.2	-18.9
TU	-17.7	-16.1	-16.0	-19.1
Time:	23:34	23:47	00:18	00:30

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	30.5	31.5
8	/	31.0	32.5
Flap	/	25.0	32.0
Time:	23:46	00:19	00:32

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	112	8
3			
4			
5	134	200	12
6			
7			
8	127	127	10
Flap	20	3	9
Time:	23:45	00:20	00:31

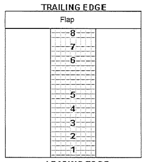
CYCLE TRACKING

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

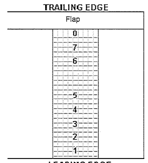


LEADING EDGE

Comments:

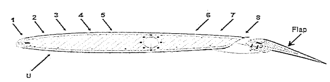
Wing and Plate Condition After the Takeoff Run
Time: ______

TRAILING EDGE



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 C13: Run # 13

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022 Run: 14 (P079)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.3	-15.1	/	-19.3
T5	-17.8	-15.0	/	-19.2
TU	-18.5	-13.3	/	-19.7
Time:	00:57	1:08	/	1:20

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.25	/	36.5
8	/	/	/
Flap	/	/	/
Time:	1:08	/	1:23

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	150	/	6
3		/	
4		/	
5	150	/	12
6		/	
7		/	
8	158	\	9
Flap	45	\	11
Time:	1:08	\	1:24

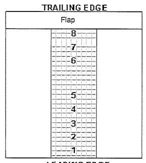
CYCLE TRACKING

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

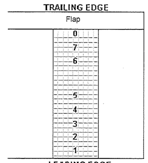


LEADING EDGE

Comments:

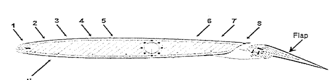
Wing and Plate Condition After the Takeoff Run
Time: ______

TRAILING EDGE



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 C14: Run # 14

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022   Run: 15 (P105)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.9	-15.3		-20.3
T5	-18.5	-14.2		-20.2
TU	-18.6	-17.7		-19.6
Time:	1:34	1:45		1:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5		34.75
8			
Flap			
Time:	1:45		1:57

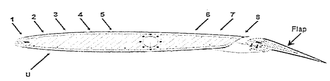
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127		4
3			
4			
5	250		12
6			
7			
8	158		16
Flap	40		9
Time:	1:45		1:58

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
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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C15: Run # 15

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022   Run: 16 (P129)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.1	-15.20		-20.3
T5	-16.0	-14.0		-19.8
TU	-18.6	-18.5		-20.5
Time:	2:07	22:18		2:29

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25		37.75
8			
Flap			
Time:	22:18		2:32

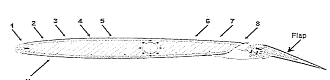
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134		11
3			
4			
5	200		14
6			
7			
8	119		35
Flap	40		12
Time:	22.18		2:32

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: ______
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.

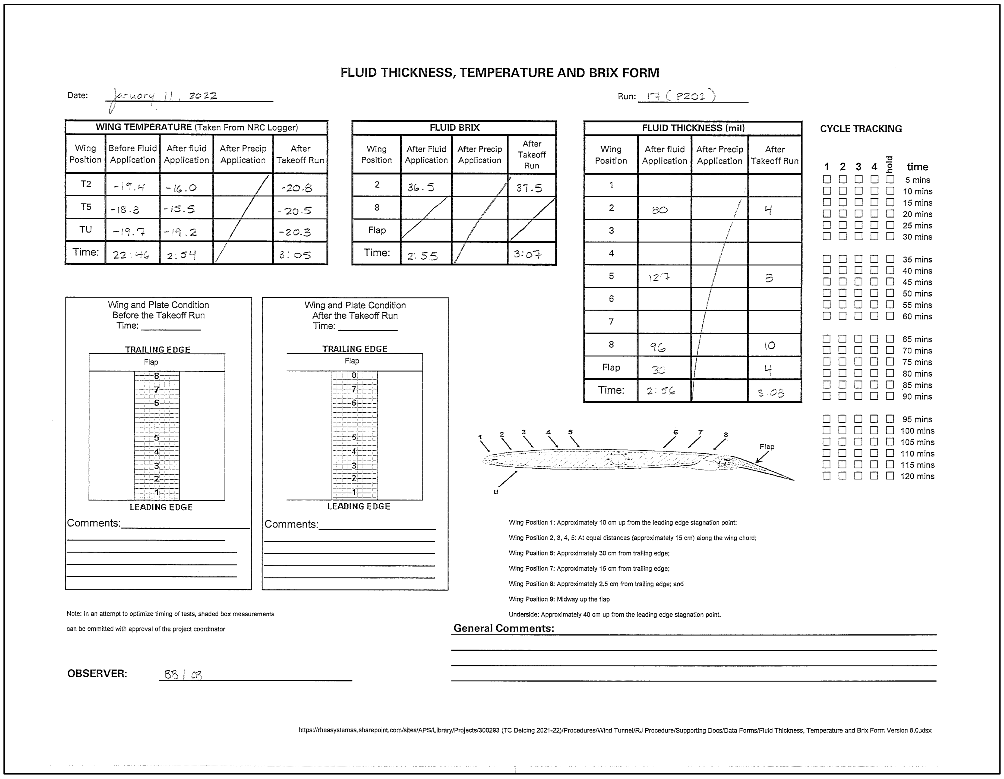
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C16: Run # 16



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022 Run: 17 (P202)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-19.4	-16.0		-20.8
T5	-18.8	-15.5		-20.5
TU	-19.7	-19.2		-20.3
Time:	22:46	2:54		3:05

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5		37.5
8			
Flap			
Time:	2:55		3:07

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80		4
3			
4			
5	127		3
6			
7			
8	96		10
Flap	30		4
Time:	2:56		3:08

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.

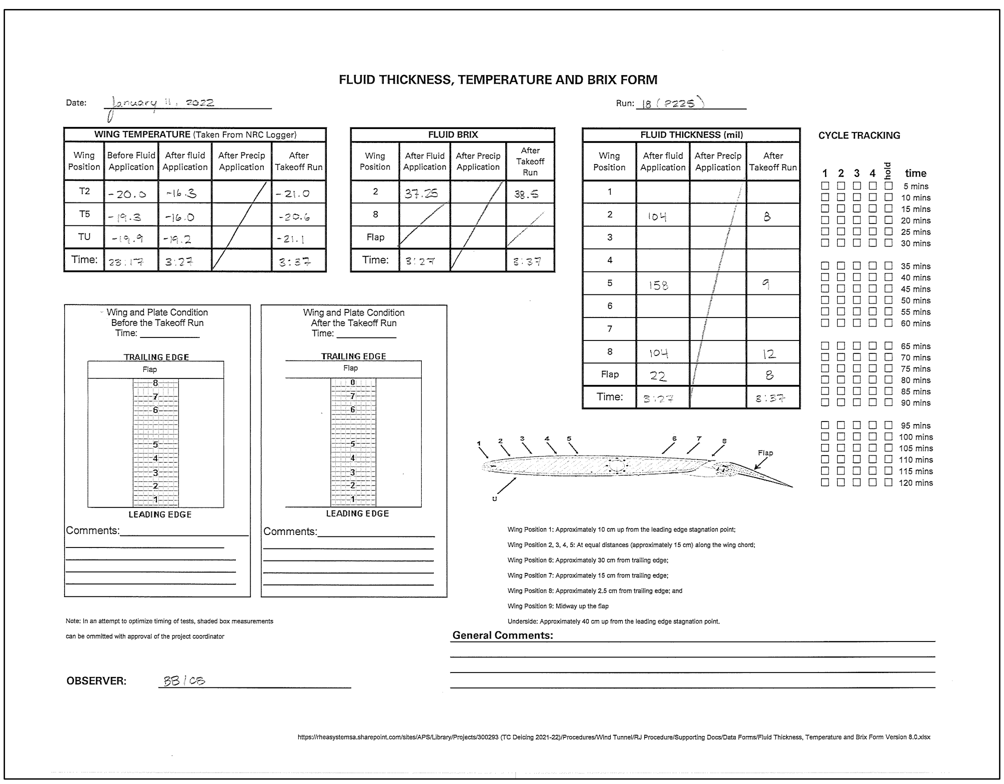
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C17: Run # 17



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022 Run: 18 (P225)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-20.0	-16.3		-21.0
T5	-19.3	-16.0		-20.6
TU	-19.9	-19.2		-21.1
Time:	23:17	3:27		3:37

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25		38.5
8			
Flap			
Time:	3:27		3:37

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104		8
3			
4			
5	158		9
6			
7			
8	104		12
Flap	22		8
Time:	3:27		3:37

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: ______

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.

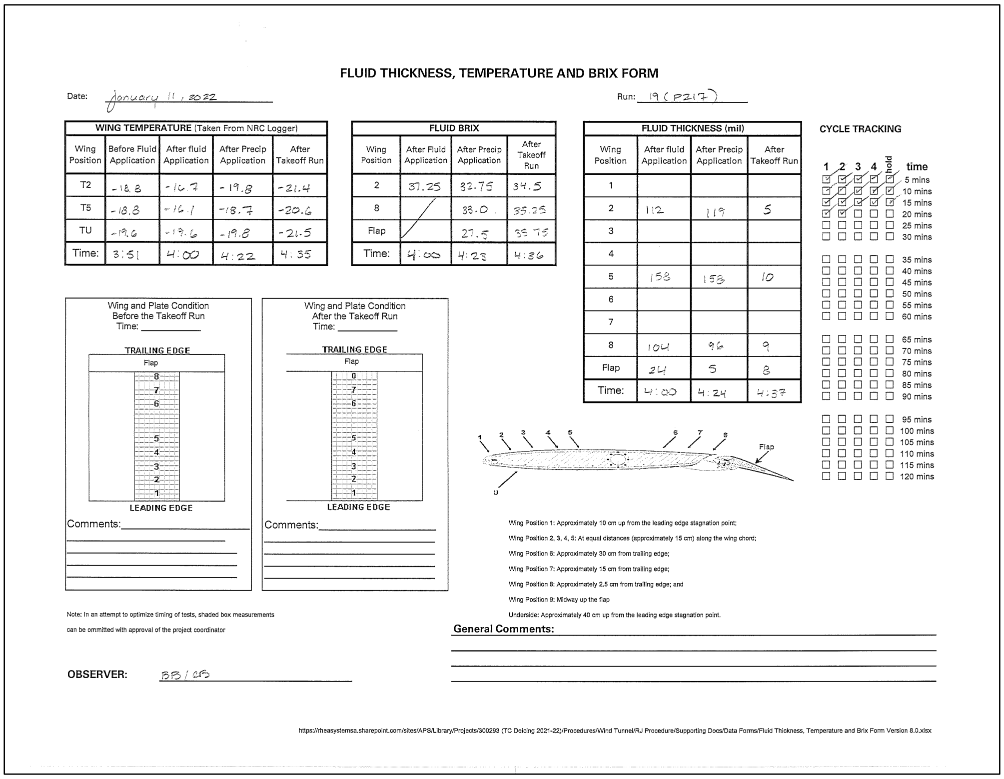
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C18: Run # 18



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022

Run: 19 (P217)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.8	-16.7	-19.8	-21.4
T5	-18.8	-16.1	-18.7	-20.6
TU	-19.6	-19.6	-19.8	-21.5
Time:	3:51	4:00	4:22	4:35

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	32.75	34.5
8	/	33.0	35.25
Flap	/	27.5	33.75
Time:	4:00	4:23	4:36

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	119	5
3			
4			
5	158	158	10
6			
7			
8	104	96	9
Flap	24	5	8
Time:	4:00	4:24	4:37

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 / LEADING EDGE

Comments:

Wing and Plate Condition After the Takeoff Run
Time: ______

TRAILING EDGE / Flap / 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.

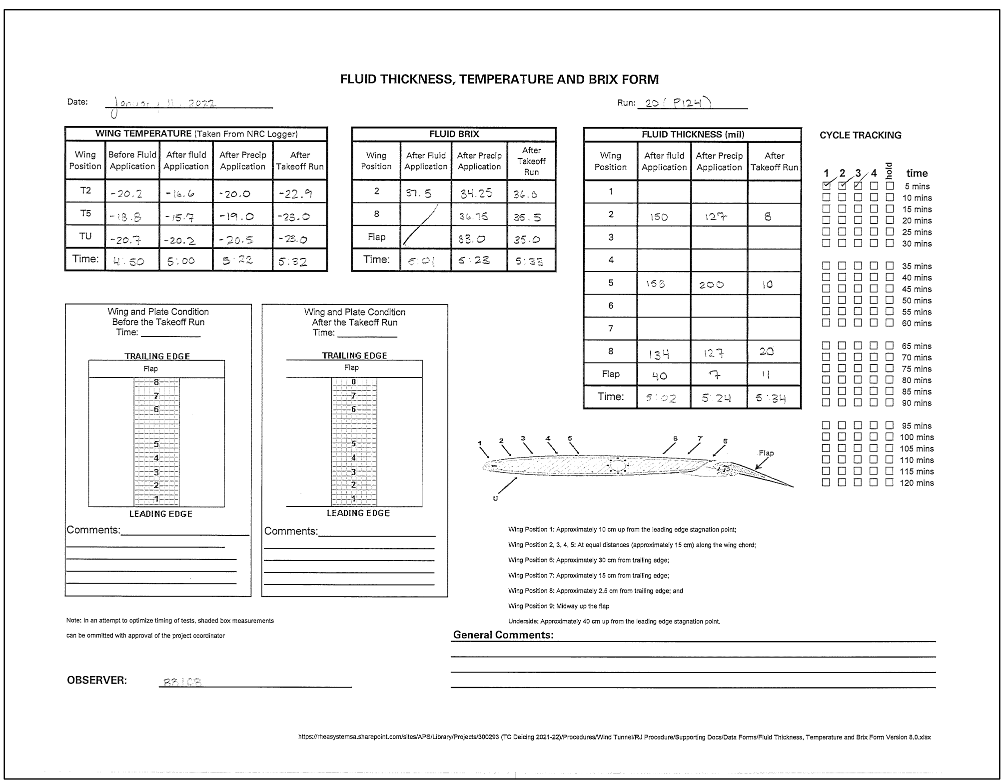
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C19: Run # 19



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022

Run: 20 (P124)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-20.2	-16.6	-20.0	-22.9
T5	-18.8	-15.7	-19.0	-23.0
TU	-20.7	-20.2	-20.5	-23.0
Time:	4:50	5:00	5:22	5:32

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	34.25	36.0
8	/	36.75	35.5
Flap	/	33.0	35.0
Time:	5:01	5:23	5:33

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150	127	8
3			
4			
5	158	200	10
6			
7			
8	134	127	20
Flap	40	7	11
Time:	5:02	5:24	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: ______

TRAILING EDGE / Flap / LEADING EDGE

Comments:

Wing and Plate Condition After the Takeoff Run
Time: ______

TRAILING EDGE / Flap / 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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C20: Run # 20

No Data Available

Figure C21: Run # 21

No Data Available

Figure C22: Run # 22

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022 Run: 23 (P626)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.3	-13.8	-19.2	-16.5
T5	-14.5	-13.0	-17.5	-15.3
TU	-14.2	-12.7	-16.1	-16.3
Time:	21:42	21:52	21:20	22:34

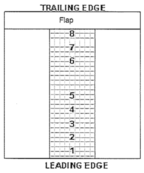
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	25.75	31.5
8	/	28.5	27.0
Flap	/	20.0	29.25
Time:	21:53	21:21	22:35

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	158	158	4
3			
4			
5	200	250	8
6			
7			
8	127	158	8
Flap	80	5	6
Time:	21:54	21:22	22:36

CYCLE TRACKING

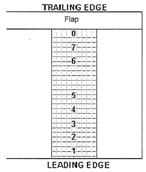
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ________

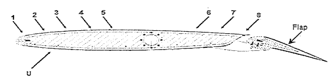


Comments:

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: PR / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C23: Run # 23

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 11, 2022 Run: 24 (P655)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.2	-14.6	-19.2	-17.6
T5	-13.4	-13.9	-18.3	-17.1
TU	-14.8	-14.6	-16.3	-17.0
Time:	22:44	22:54	23:22	23:33

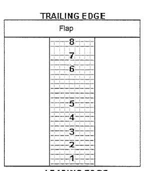
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.5	24.75	26.5
8	/	24.25	27.25
Flap	/	19.0	27.75
Time:	22:55	23:23	23:34

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	158	2
3			
4			
5	119	200	4
6			
7			
8	80	127	8
Flap	30	4	6
Time:	22:56	23:24	23:35

CYCLE TRACKING

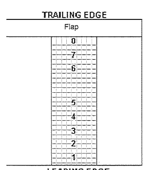
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ________

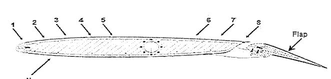


Comments:

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

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C24: Run # 24

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 25 (P123)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.6	-15.2	-18.0	
T5	-13.6	-14.2	-15.8	
TU	-15.6	-16.0	-16.2	
Time:	23:48	23:58	00:10	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	27.75	
8	/	32.5	
Flap	/	29.5	
Time:	23:59	00:12	

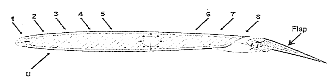
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	142	127	
3			
4			
5	158	200	
6			
7			
8	127	134	
Flap	40	18	
Time:	00:00	00:14	

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
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: See comments on general form

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C25: Run # 25

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 26 (P123)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.6	-13.6	-16.6	-15.5
T5	-11.7	-13.0	-14.5	-15.1
TU	-12.2	-13.4	-13.8	-15.5
Time:	2:25	2:34	2:47	2:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	28.0	32.0
8	/	35.5	33.5
Flap	/	27.25	33.0
Time:	2:35	2:48	3:0

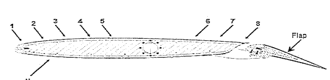
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150	150	10
3			
4			
5	158	200	12
6			
7			
8	134	158	14
Flap	65	35	10
Time:	2:36	2:49	3:0

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C26: Run # 26

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 27 (P128)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.6	-13.8		-14.2
T5	-11.8	-12.9		-13.5
TU	-13.0	-12.7		-14.3
Time:	3:12	3:22		3:37

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75		37.0
8			
Flap			
Time:	3:23		3:37

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150		11
3			
4			
5	158		12
6			
7			
8	119		18
Flap	50		9
Time:	3:24		3:37

CYCLE TRACKING

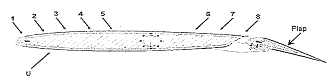
1 2 3 4 hold time: 5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

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 / 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: RR / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C27: Run # 27

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 28 (P217)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.1	-12.5	-15.0	-14.6
T5	-10.7	-11.7	-13.5	-13.7
TU	-11.6	-12.3	-13.6	-14.6
Time:	3.51	4:02	4:33	4:46

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	35.0	30.0
8		30.75	31.0
Flap		24.0	30.75
Time:	4:01	4:34	4:48

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	134	9
3			
4			
5	142	158	9
6			
7			
8	104	134	14
Flap	30	11	10
Time:	4:00	4:35	4:50

CYCLE TRACKING

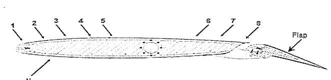
1 2 3 4 hold time: 5 mins ☑☑☑☑☑, 10 mins ☑☑☑☑☑, 15 mins ☑☑☑☑☑, 20 mins ☑☑☑☑☑, 25 mins ☑☑☑☑☑, 30 mins ☑☑☑☑☑, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

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 / 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 / CR

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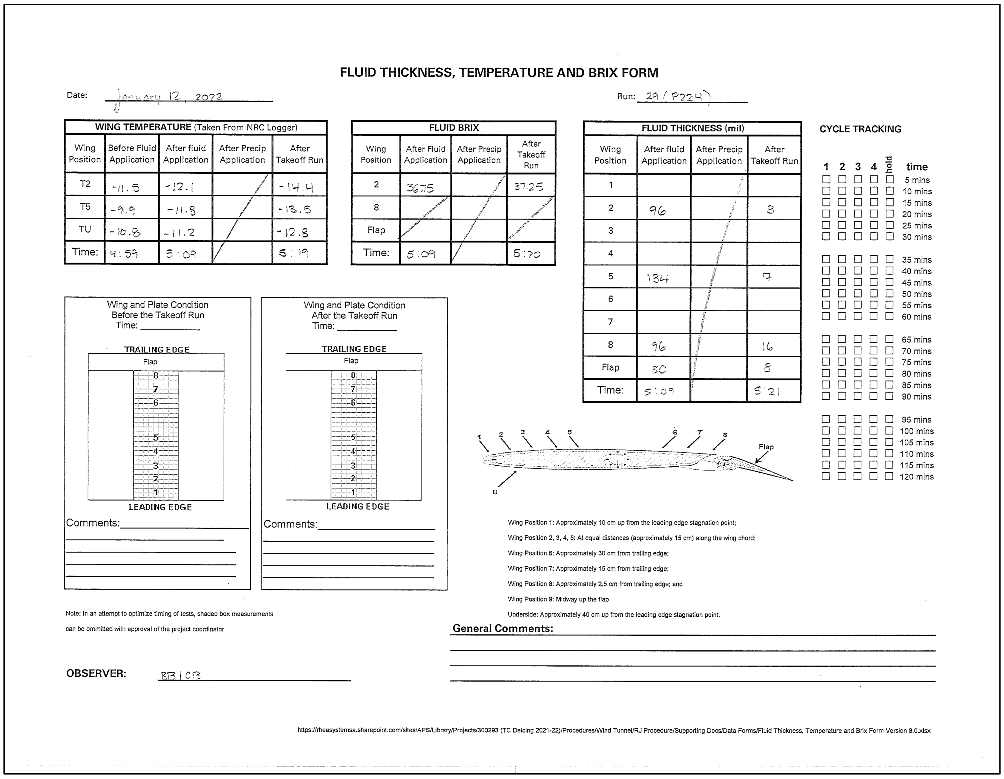
Figure C28: Run # 28



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 29 (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.5	-12.1		-14.4
T5	-9.9	-11.8		-13.5
TU	-10.8	-11.2		-12.8
Time:	4:59	5:09		5:19

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75		37.25
8			
Flap			
Time:	5:09		5:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96		8
3			
4			
5	134		7
6			
7			
8	96		16
Flap	30		8
Time:	5:09		5:21

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: RB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

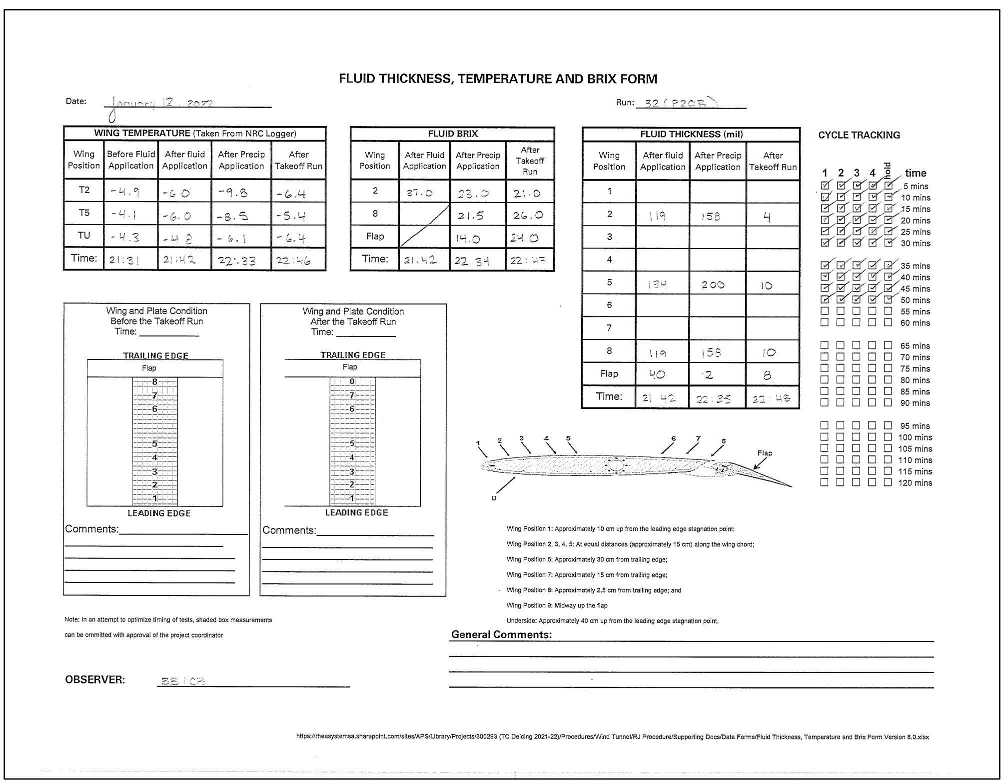
Figure C29: Run # 29

No Data Available

Figure C30: Run # 30

No Data Available

Figure C31: Run # 31



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 12, 2022

Run: 32 (P203)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.9	-6.0	-9.8	-6.4
T5	-4.1	-6.0	-8.5	-5.4
TU	-4.3	-4.8	-6.1	-6.4
Time:	21:31	21:42	22:33	22:46

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	23.0	21.0
8	/	21.5	26.0
Flap	/	14.0	24.0
Time:	21:42	22:34	22:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	4
3			
4			
5	134	200	10
6			
7			
8	119	158	10
Flap	40	2	8
Time:	21:42	22:35	22:48

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
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.

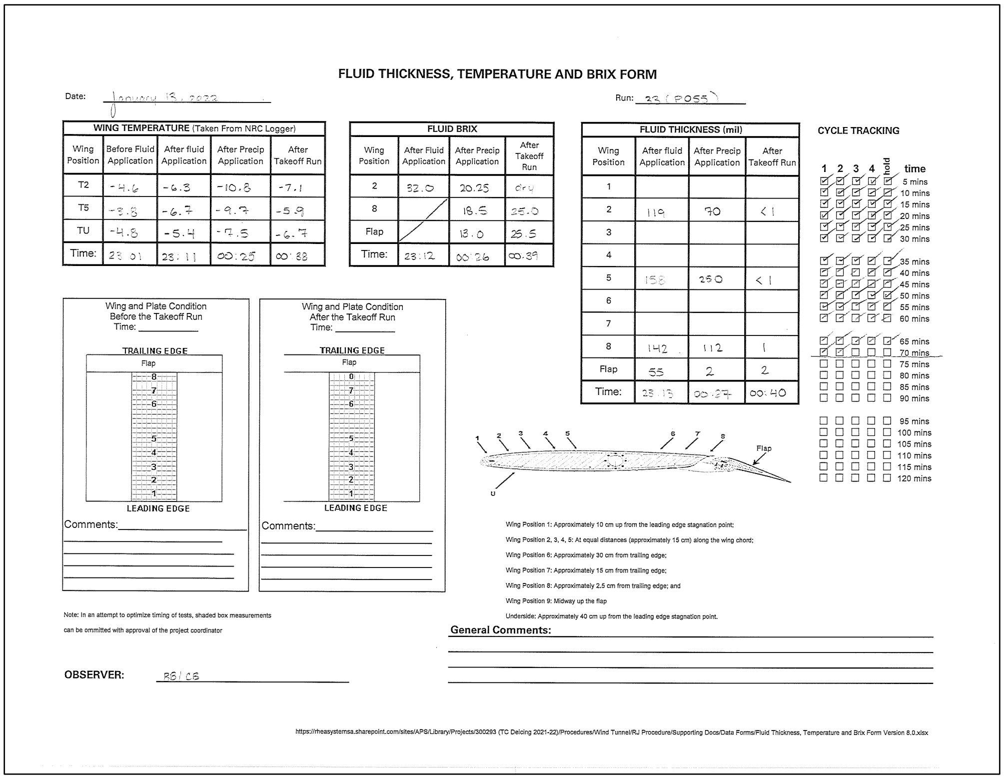
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C32: Run # 32



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022 Run: 33 (P055)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.6	-6.3	-10.8	-7.1
T5	-3.8	-6.7	-9.7	-5.9
TU	-4.8	-5.4	-7.5	-6.7
Time:	23:01	23:11	00:25	00:38

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.0	20.25	dry
8	/	18.5	25.0
Flap	/	13.0	25.5
Time:	23:12	00:26	00:39

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	70	< 1
3			
4			
5	158	250	< 1
6			
7			
8	142	112	1
Flap	55	2	2
Time:	23:13	00:27	00:40

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run
Time:

Wing and Plate Condition After the Takeoff Run
Time:

TRAILING EDGE / Flap / LEADING EDGE

Comments:

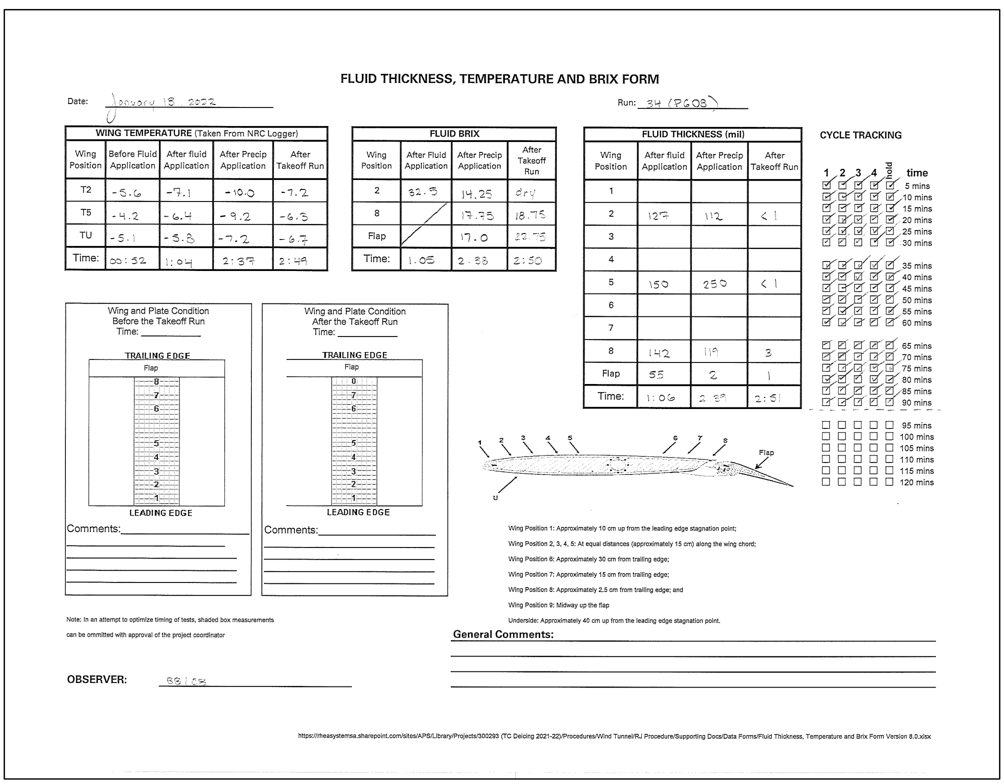
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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: RB/CB

Figure C33: Run # 33



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022 Run: 34 (P608)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.6	-7.1	-10.0	-7.2
T5	-4.2	-6.4	-9.2	-6.3
TU	-5.1	-5.8	-7.2	-6.7
Time:	00:52	1:04	2:37	2:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	14.25	dry
8	/	17.75	18.75
Flap	/	17.0	22.75
Time:	1.05	2:38	2:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	112	< 1
3			
4			
5	150	250	< 1
6			
7			
8	142	119	3
Flap	55	2	1
Time:	1:06	2:39	2:51

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run
Time:

Wing and Plate Condition After the Takeoff Run
Time:

TRAILING EDGE / Flap / LEADING EDGE

Comments:

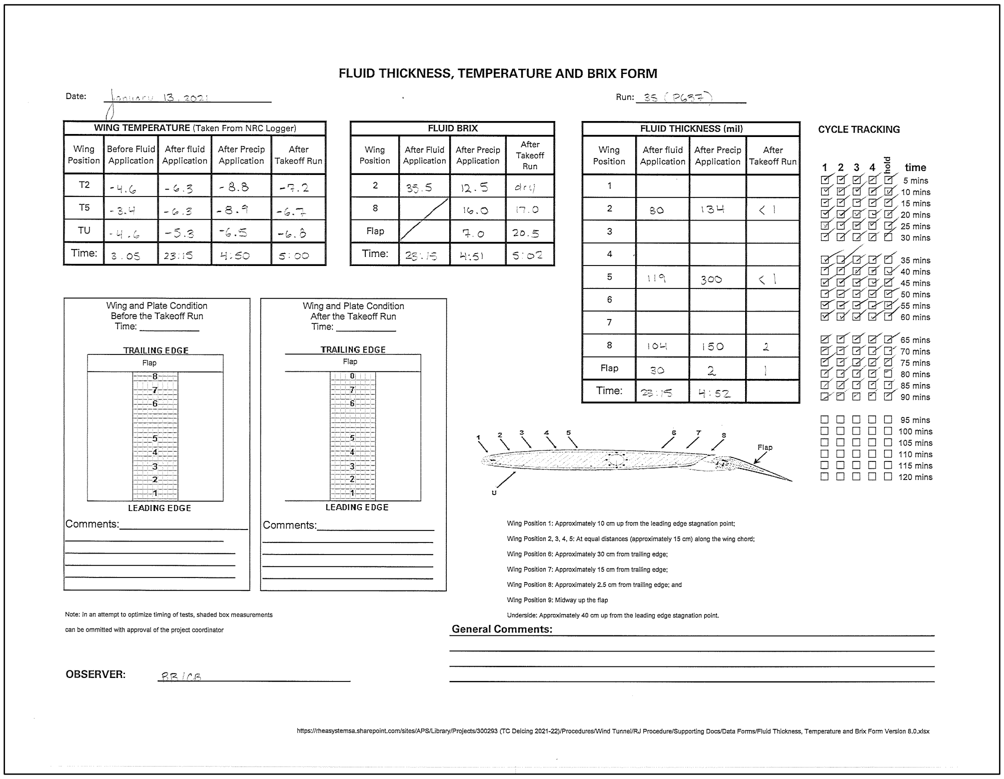
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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 C34: Run # 34



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2021

Run: 35 (P637)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.6	-6.3	-8.8	-7.2
T5	-3.4	-6.3	-8.9	-6.7
TU	-4.6	-5.3	-6.5	-6.8
Time:	3.05	23:15	4:50	5:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.5	12.5	dry
8	/	16.0	17.0
Flap	/	7.0	20.5
Time:	23:15	4:51	5:02

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	134	< 1
3			
4			
5	119	300	< 1
6			
7			
8	104	150	2
Flap	30	2	1
Time:	23:15	4:52	

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/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

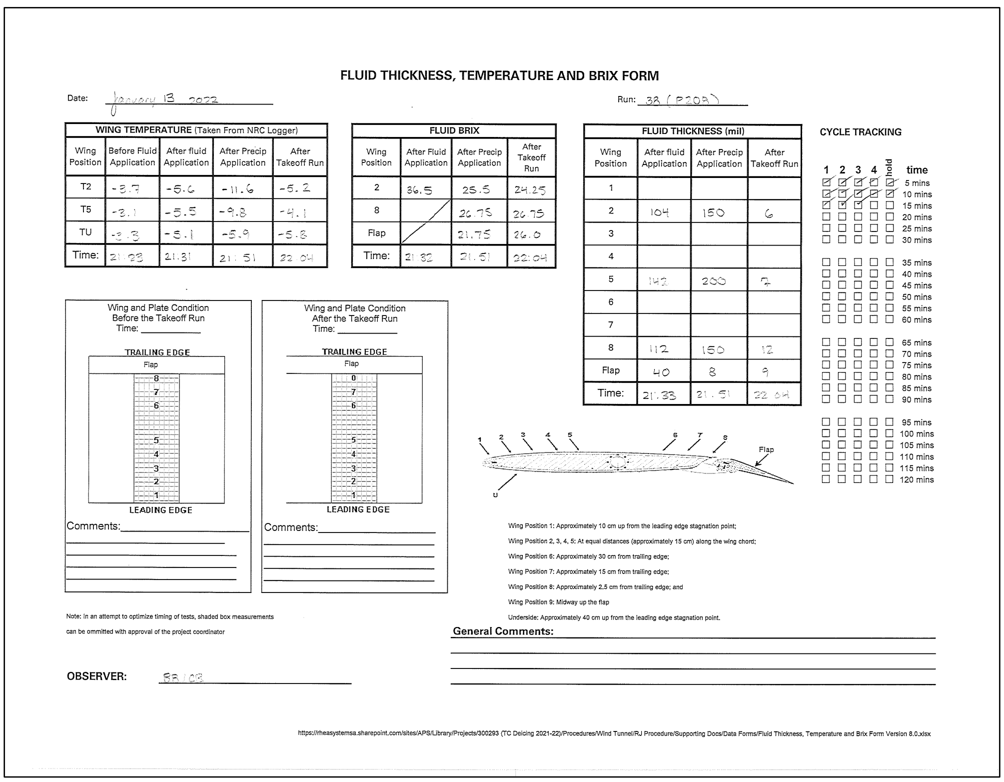
Figure C35: Run # 35

No Data Available

Figure C36: Run # 36

No Data Available

Figure C37: Run # 37



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13 2022

Run: 38 (P20A)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.7	-5.6	-11.6	-5.2
T5	-3.1	-5.5	-9.8	-4.1
TU	-3.3	-5.1	-5.9	-5.8
Time:	21:23	21:31	21:51	22:04

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	25.5	24.25
8	/	26.75	26.75
Flap	/	21.75	26.0
Time:	21:32	21:51	22:04

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	150	6
3			
4			
5	142	200	7
6			
7			
8	112	150	12
Flap	40	8	9
Time:	21:33	21:51	22:04

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: SB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C38: Run # 38

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 13, 2022 Run: 39 (P642)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.5	-5.4	-11.5	-7.0
T5	-3.6	-5.4	-12.1	-6.2
TU	-4.7	-4.8	-8.4	-6.5
Time:	22:15	22:24	23:14	23:28

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.75	14.25	dry
8		19.5	21.0
Flap		dry	21.25
Time:	22:25	23:15	23:30

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	250	<1
3			
4			
5	142	300	<1
6			
7			
8	112	158	8
Flap	30	<1	1
Time:	22:26	23:16	23:32

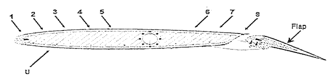
CYCLE TRACKING

1 2 3 4 hold time

5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins (current AT), 40 mins, 45 mins (expansion), 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 C39: Run # 39

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2022 Run: 40 (P086)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-4.1	-5.3	-13.3	-7.4
T5	-3.3	-5.3	-12.1	-6.0
TU	-3.5	-4.9	-8.7	-6.6
Time:	23:46	23:58	00:37	00:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	23.25	dry
8		21.0	23.5
Flap		19.0	22.25
Time:	00:00	00:38	00:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	158	<1
3			
4			
5	142	300	<1
6			
7			
8	158	158	8
Flap	40	1	3
Time:	00:00	00:39	00:51

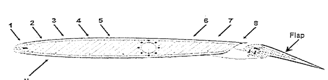
CYCLE TRACKING

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.

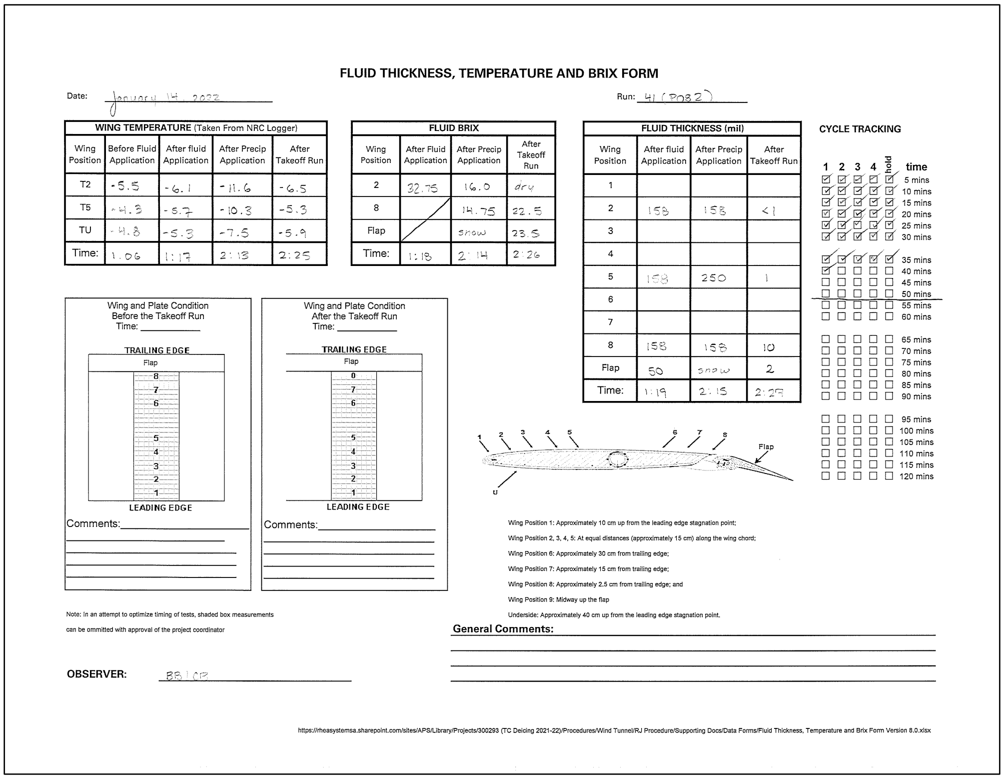
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C40: Run # 40



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2022 Run: 41 (P082)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.5	-6.1	-11.6	-6.5
T5	-4.3	-5.7	-10.3	-5.3
TU	-4.8	-5.3	-7.5	-5.9
Time:	1.06	1:17	2:13	2:25

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	16.0	dry
8		14.75	22.5
Flap		snow	23.5
Time:	1:18	2:14	2:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	158	158	<1
3			
4			
5	158	250	1
6			
7			
8	158	158	10
Flap	50	snow	2
Time:	1:19	2:15	2:27

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ______

Wing and Plate Condition After the Takeoff Run Time: ______

TRAILING EDGE / 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.

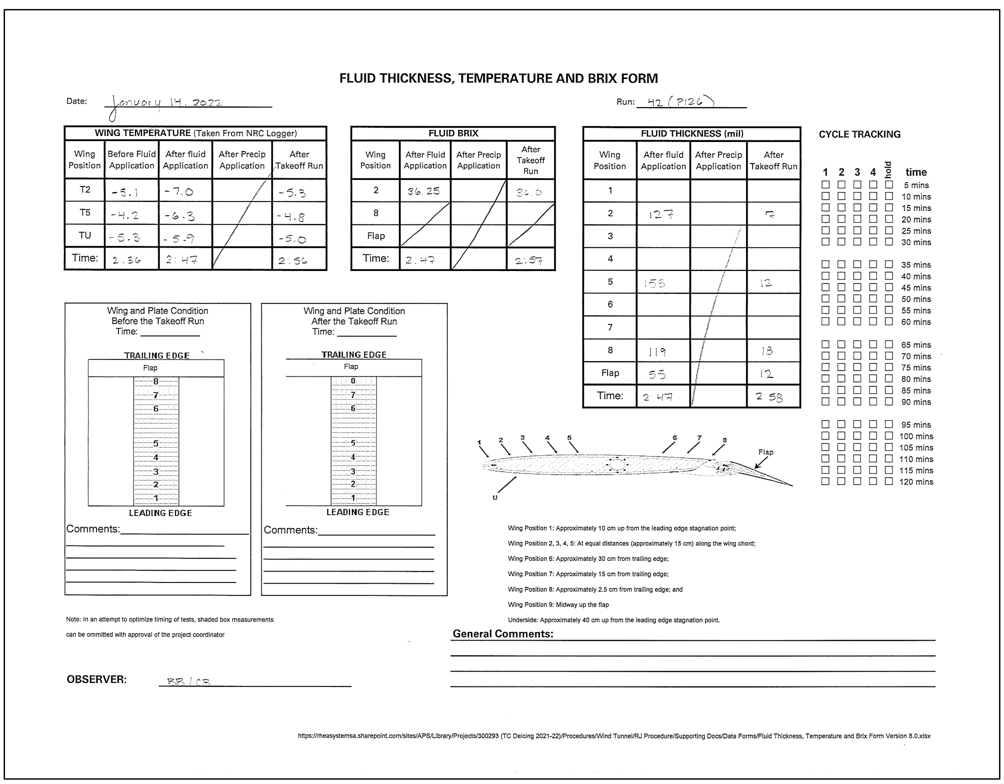
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C41: Run # 41



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2022 Run: 42 (P126)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.1	-7.0		-5.3
T5	-4.2	-6.3		-4.8
TU	-5.3	-5.9		-5.0
Time:	2:36	2:47		2:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25		36.0
8			
Flap			
Time:	2:47		2:57

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127		7
3			
4			
5	158		12
6			
7			
8	119		18
Flap	55		12
Time:	2:47		2:58

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ______

Wing and Plate Condition After the Takeoff Run Time: ______

TRAILING EDGE / 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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C42: Run # 42

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2022   Run: 43 (P108)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.9	-5.0	-104	-6.8
T5	-3.0	-5.7	-8.3	-5.8
TU	-3.7	-4.2	-6.6	-6.9
Time:	3:14	3:23	4:11	4:26

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	22.25	22.0
8	/	22.5	27.5
Flap	/	10.0	26.5
Time:	3:23	4:12	4:27

FLUID THICKNESS (mil)

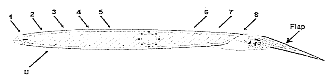
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	150	7
3			
4			
5	150	250	8
6			
7			
8	119	158	18
Flap	45	80/slush	11
Time:	3:23	4:13	4:28

CYCLE TRACKING

1 2 3 4 hold time
5 mins … 120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ____
TRAILING EDGE
Flap
LEADING EDGE
Comments:

Wing and Plate Condition After the Takeoff Run
Time: ____
TRAILING EDGE
Flap
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 C43: Run # 43

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 14, 2022   Run: 44 (P222)

WING TEMPERATURE (Taken From NRC Logger)

Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.9	-6.0	/	-6.9
T5	-5.4	-5.9	/	-6.6
TU	-6.1	-6.2	/	-6.7
Time:	4:40	4:50	/	4:59

FLUID BRIX

Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.5	/	36.5
8	/	/	/
Flap	/	/	/
Time:	4:51	/	5:01

FLUID THICKNESS (mil)

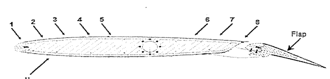
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	112	/	6
3		/	
4		/	
5	158	/	8
6		/	
7		/	
8	112	/	16
Flap	35	/	8
Time:	4:52		5:03

CYCLE TRACKING

1 2 3 4 hold time
5 mins … 120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ____
TRAILING EDGE
Flap
LEADING EDGE
Comments:

Wing and Plate Condition After the Takeoff Run
Time: ____
TRAILING EDGE
Flap
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

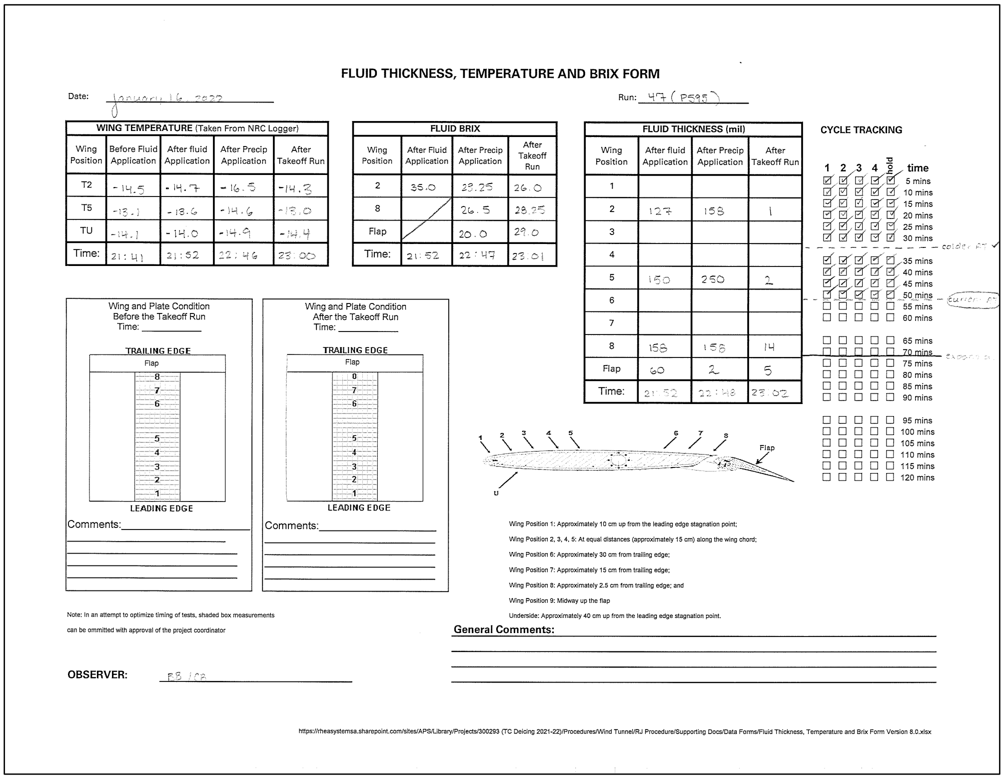
Figure C44: Run # 44

No Data Available

Figure C45: Run # 45

No Data Available

Figure C46: Run # 46



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 16, 2022

Run: 47 (P595)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.5	-14.7	-16.5	-14.3
T5	-13.1	-13.6	-14.6	-13.0
TU	-14.1	-14.0	-14.9	-14.4
Time:	21:41	21:52	22:46	23:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	23.25	26.0
8		26.5	28.25
Flap		20.0	29.0
Time:	21:52	22:47	23:01

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	158	1
3			
4			
5	150	250	2
6			
7			
8	158	158	14
Flap	60	2	5
Time:	21:52	22:48	23:02

CYCLE TRACKING

1 2 3 4 hold time: 5 mins to 50 mins checked; 55 mins to 120 mins unchecked

colder AT ✓ (after 30 mins); current AT (after 50 mins); exposure (after 70 mins)

Wing and Plate Condition Before the Takeoff Run Time: ______

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

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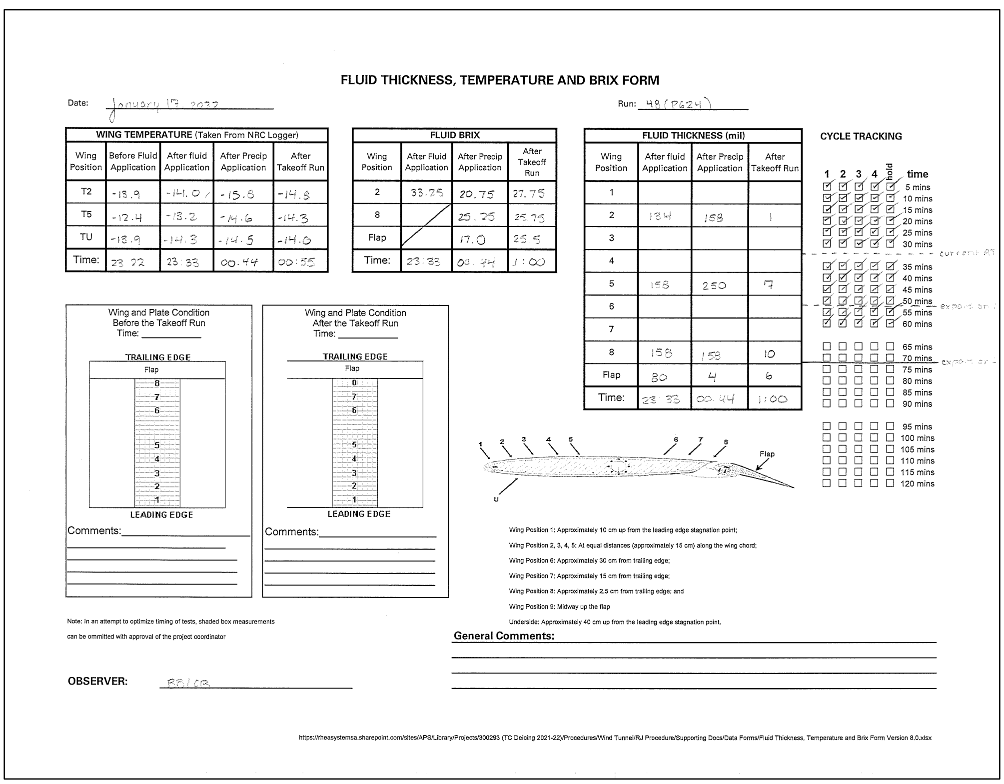
Figure C47: Run # 47



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2022

Run: 48 (P624)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.9	-14.0	-15.5	-14.8
T5	-12.4	-13.2	-14.6	-14.3
TU	-13.9	-14.3	-14.5	-14.0
Time:	23 22	23:33	00:44	00:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	20.75	27.75
8		25.25	25.75
Flap		17.0	25.5
Time:	23:33	00:44	1:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	158	1
3			
4			
5	158	250	7
6			
7			
8	158	158	10
Flap	80	4	6
Time:	23 33	00.44	1:00

CYCLE TRACKING

1 2 3 4 hold time: 5 mins to 60 mins checked; 65 mins to 120 mins unchecked

current AT (after 30 mins); exposure (after 50 mins); exposure (after 70 mins)

Wing and Plate Condition Before the Takeoff Run Time: ______

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C48: Run # 48

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17 2022

Run: 49 (P653)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.2	-13.5	-14.7	-13.4
T5	-10.5	-12.9	-14.2	-12.6
TU	-11.9	-12.8	-13.6	-13.0
Time:	1:13	1:23	2:25	2:36

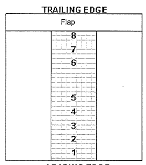
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	19.25	dry
8	/	21.75	23.0
Flap	/	18.0	25.0
Time:	1:23	2:26	2:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	119	< 1
3			
4			
5	134	250	9
6			
7			
8	80	142	10
Flap	30	1 / slush	3
Time:	1:23	2:27	2:39

CYCLE TRACKING

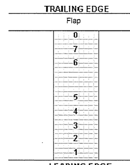
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☑	☑	☑	☑	☑	35 mins
☑	☑	☑	☑	☑	40 mins
☑	☑	☑	☑	☑	45 mins
☑	☑	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ____________

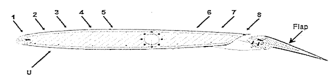


Comments: ____________

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C49: Run # 49

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2022

Run: 50 (P121)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.7	-12.9	-13.6	-10.9
T5	-10.5	-12.6	-12.5	-9.5
TU	-11.9	-12.3	-12.1	-10.9
Time:	3:02	3:14	3:49	4:02

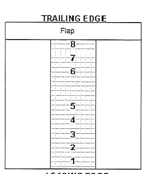
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	17.75	15.5
8	/	25.0	30.0
Flap	/	24.0	28.75
Time:	3 15	3:50	4:03

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	134	7
3			
4			
5	150	200	11
6			
7			
8	119	134	18
Flap	50	55	9
Time:	3:16	3:51	4:04

CYCLE TRACKING

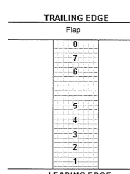
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ____________

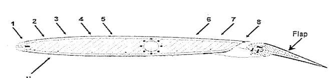


Comments: ____________

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.

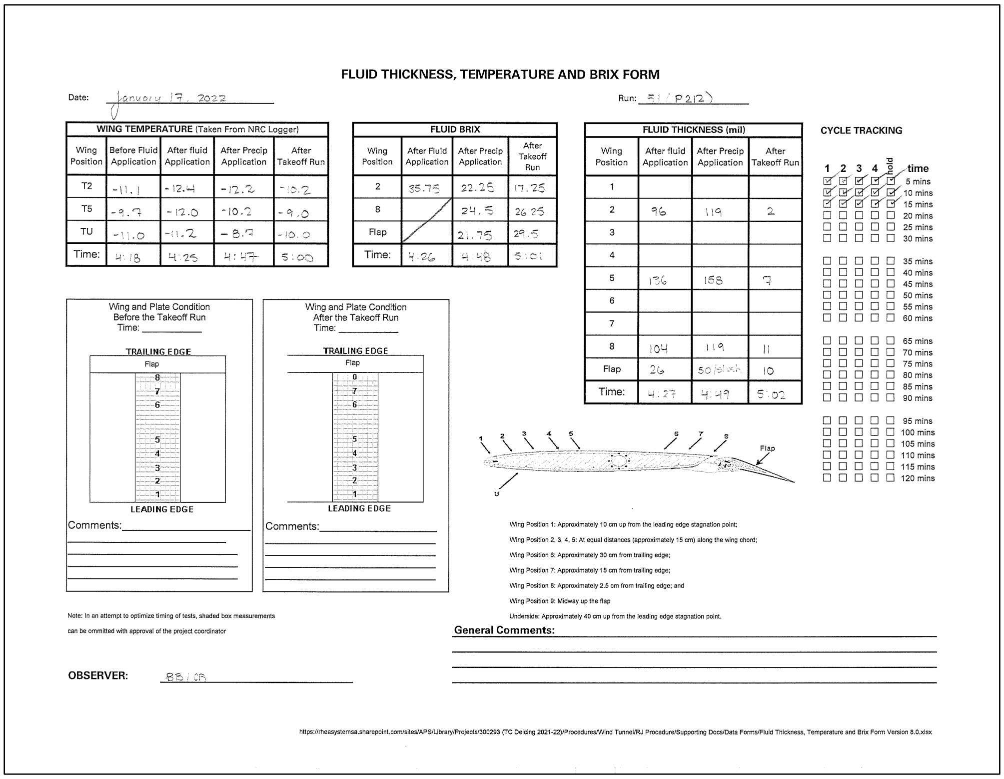
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: Snow on wing after run from storm outside

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C50: Run # 50



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2022

Run: 51 (P212)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.1	-12.4	-12.2	-10.2
T5	-9.7	-12.0	-10.2	-9.0
TU	-11.0	-11.2	-8.7	-10.0
Time:	4:18	4:25	4:47	5:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.75	22.25	17.25
8		24.5	26.25
Flap		21.75	29.5
Time:	4:26	4:48	5:01

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	119	2
3			
4			
5	136	158	7
6			
7			
8	104	119	11
Flap	26	50/slush	10
Time:	4:27	4:49	5:02

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 / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

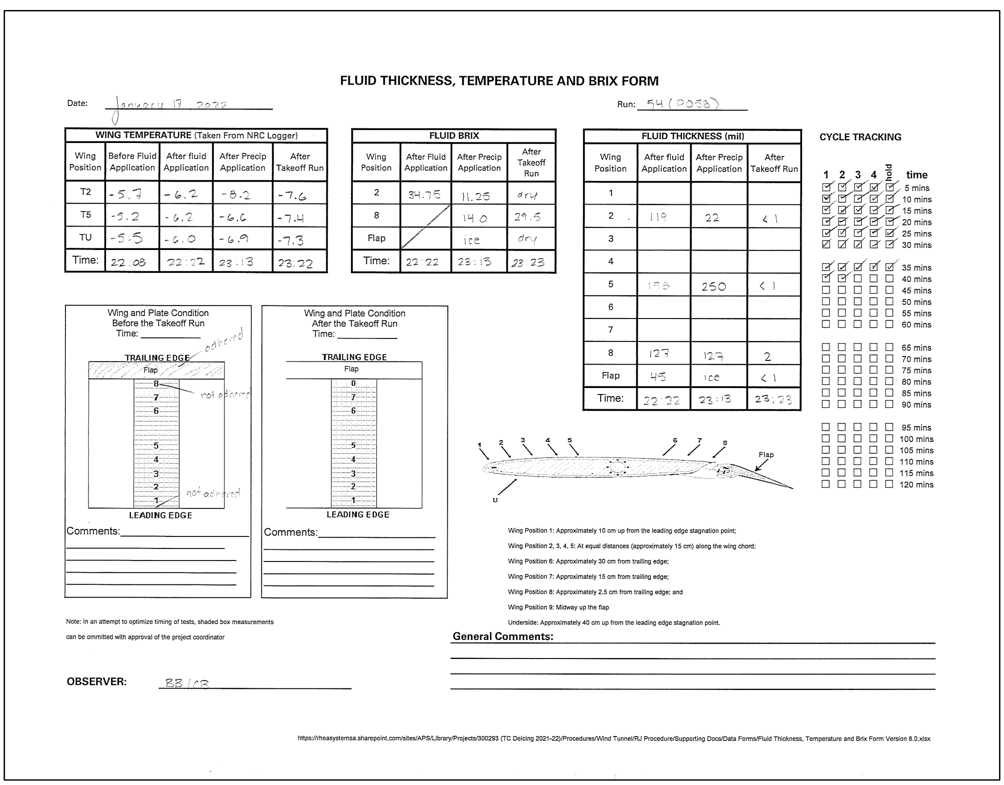
Figure C51: Run # 51

No Data Available

Figure C52: Run # 52

No Data Available

Figure C53: Run # 53



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 17, 2022

Run: 54 (P058)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.7	-6.2	-8.2	-7.6
T5	-5.2	-6.2	-6.6	-7.4
TU	-5.5	-6.0	-6.9	-7.3
Time:	22:08	22:22	23:13	23:22

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	11.25	dry
8	/	14.0	29.5
Flap	/	ice	dry
Time:	22:22	23:13	23:23

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	22	< 1
3			
4			
5	158	250	< 1
6			
7			
8	127	127	2
Flap	45	ice	< 1
Time:	22:22	23:13	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:
TRAILING EDGE — adhered
Flap
8 — not adhered
7
6
5
4
3
2
1 — not adhered
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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C54: Run # 54

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18 2022 Run: 55 (P084)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.2	-8.6	-9.4	-8.6
T5	-7.0	-8.5	-7.5	-7.9
TU	-7.1	-7.4	-8.1	-8.3
Time:	23:43	23:53	00:37	00:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	21.0	dry
8		26.5	28.25
Flap		ice	ice
Time:	23:54	00:38	00:50

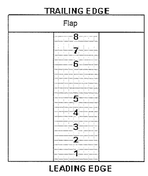
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	158	200	<1
3			
4			
5	200	300	9
6			
7			
8	127	158	10
Flap	70	ice	ice/<1
Time:	23:55	00:39	00:51

CYCLE TRACKING

1 2 3 4 hold time

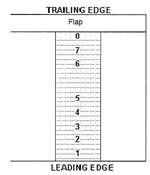
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run Time: ______

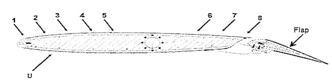


Comments: ______

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: ______

OBSERVER: BB / CB

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Figure C55: Run # 55

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18 2022 Run: 56 (P110)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-8.1	-9.0	-7.5	-9.0
T5	-7.8	-8.6	-5.7	-8.6
TU	-8.2	-9.1	-7.5	-8.3
Time:	1:07	1:20	1:47	1:57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	22.75	30.5
8		24.75	34.75
Flap		ice	22.0
Time:	1:20	1:48	1:58

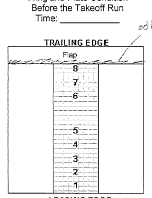
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	119	8
3			
4			
5	158	250	9
6			
7			
8	127	158	20
Flap	60	ice	40
Time:	1:20	1:49	1:59

CYCLE TRACKING

1 2 3 4 hold time

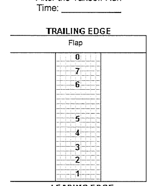
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run Time: ______

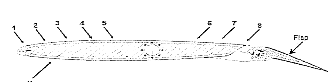


Comments: ______

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: ______

OBSERVER: BB / CB

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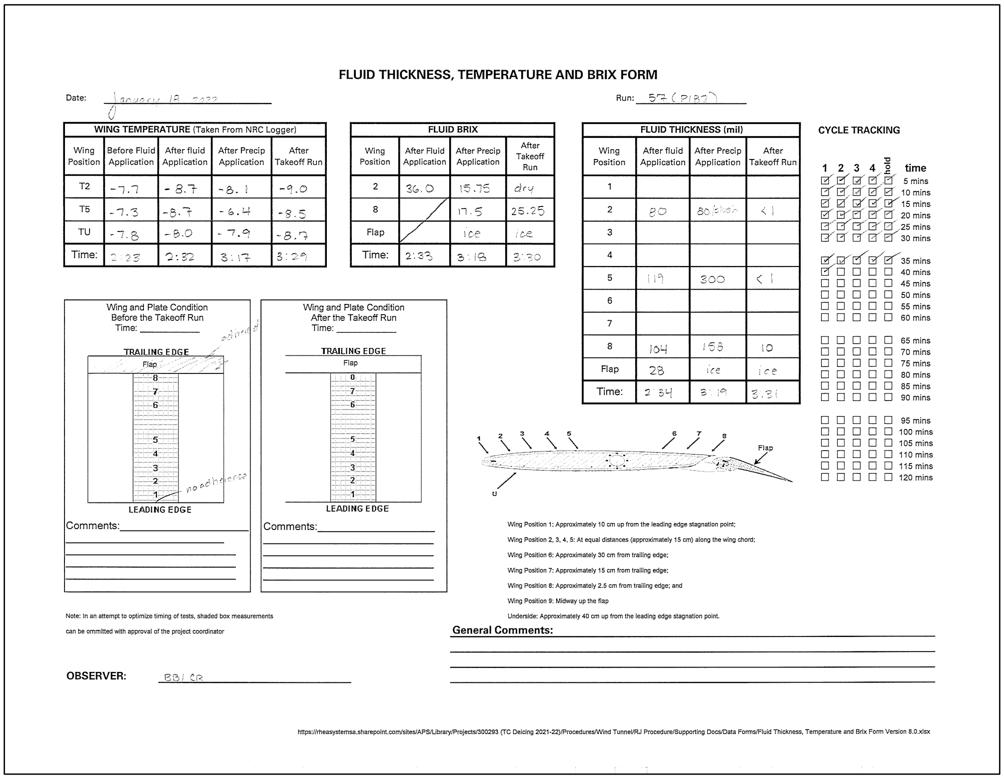
Figure C56: Run # 56



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022 Run: 57 (P182)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.7	-8.7	-8.1	-9.0
T5	-7.3	-8.7	-6.4	-8.5
TU	-7.8	-8.0	-7.9	-8.7
Time:	2:23	2:32	3:17	3:29

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	15.75	dry
8	/	17.5	25.25
Flap	/	ice	ice
Time:	2:33	3:18	3:30

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	80/slush	< 1
3			
4			
5	119	300	< 1
6			
7			
8	104	158	10
Flap	28	ice	ice
Time:	2:34	3:19	3:31

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
adhered
no adherence
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

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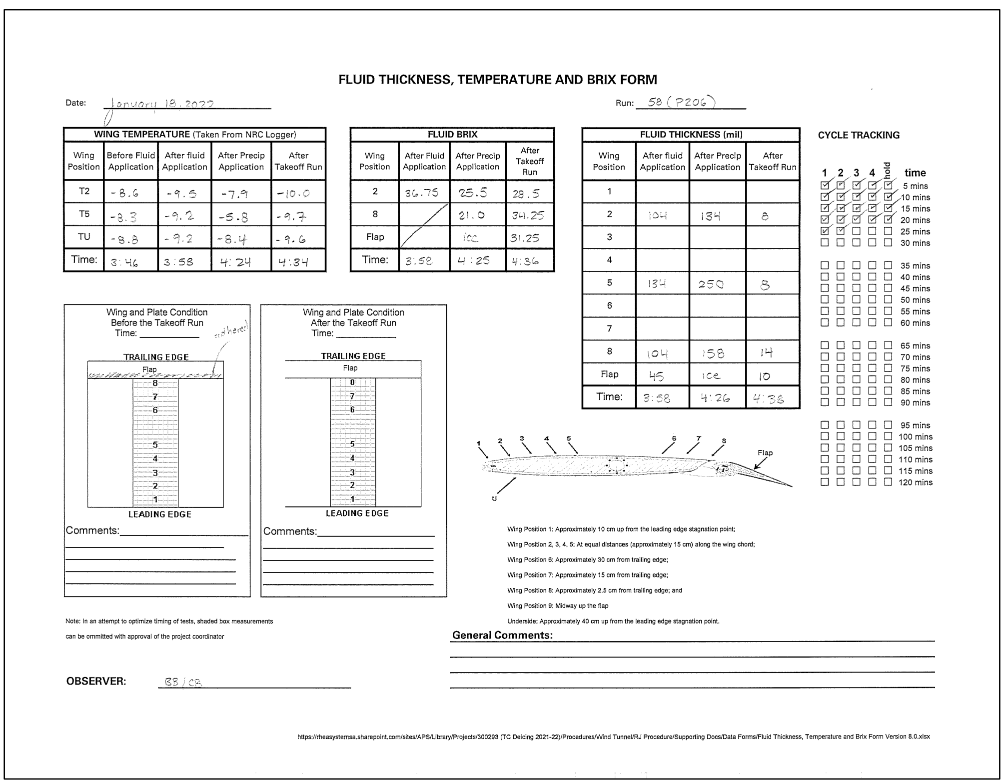
Figure C57: Run # 57



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022 Run: 58 (P206)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-8.6	-9.5	-7.9	-10.0
T5	-8.3	-9.2	-5.8	-9.7
TU	-8.8	-9.2	-8.4	-9.6
Time:	3:46	3:58	4:24	4:34

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	25.5	28.5
8	/	21.0	34.25
Flap	/	ice	31.25
Time:	3:52	4:25	4:36

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	134	8
3			
4			
5	134	250	8
6			
7			
8	104	158	14
Flap	45	ice	10
Time:	3:58	4:26	4:38

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: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
adhered
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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C58: Run # 58

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022

Run: 59 (P127)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.8	-10.5		-10.3
T5	-9.3	-10.4		-9.9
TU	-9.9	-10.3		-10.2
Time:	4:50	4:59		5:09

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0		37.0
8			
Flap			
Time:	5:00		5:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150		9
3			
4			
5	158		11
6			
7			
8	134		24
Flap	60		10
Time:	5:01		5:11

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: ____________

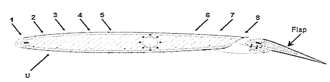
TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

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 / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C59: Run # 59

No Data Available

Figure C60: Run # 60

No Data Available

Figure C61: Run # 61

No Data Available

Figure C62: Run # 62

No Data Available

Figure C63: Run # 63

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 18, 2022

Run: 64 (F064)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.1	-11.11	-15.8	-15.6
T5	-11.7	-10.3	-13.7	-15.2
TU	-12.0	-10.9	-12.3	-15.5
Time:	22:16	22:27	23:02	23:14

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	22.0	dry
8		24.75	27.0
Flap		15.5	28.25
Time:	22:28	23:03	23:15

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	< 1
3			
4			
5	158	250	< 1
6			
7			
8	142	158	10
Flap	40	70 slush	8
Time:	22:29	23:04	23:16

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: ___________

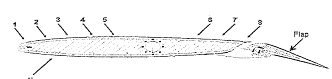
TRAILING EDGE
Flap
8
7
6
5
4
3
2
1
LEADING EDGE

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C64: Run # 64

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19 2022

Run: 65 (P090)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	12.5	-11.3	-15.4	-16.1
T5	10.8	-10.0	-14.4	-16.2
TU	11.7	-11.8	-12.7	-16.0
Time:	23:33	23:46	00:23	00:33

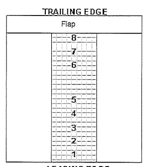
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	23.5	28.5
8	/	23.5	27.75
Flap	/	18.75	25.25
Time:	23:47	00:24	00:35

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150	158	1
3			
4			
5	200	250	6
6			
7			
8	150	158	12
Flap	70	slush35	6
Time:	23:48	00:24	00:37

CYCLE TRACKING

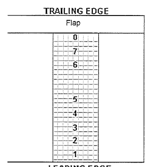
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ___________

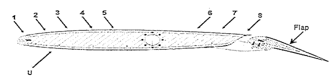


Comments:

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C65: Run # 65

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19 2022

Run: 66 (P188)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.5	-11.4	-15.7	-15.8
T5	-10.9	-11.0	-14.7	-15.8
TU	-12.4	-12.2	-13.0	-15.8
Time:	00:57	1:06	1:41	1:51

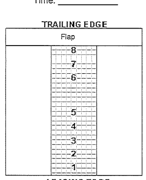
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	26.0	25.25
8	/	24.75	23.0
Flap	/	15.0	26.25
Time:	1:07	1:42	1:53

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	134	1
3			
4			
5	119	158	3
6			
7			
8	80	134	10
Flap	28	slush18	7
Time:	1:08	1:43	1:55

CYCLE TRACKING

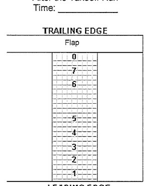
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ___________

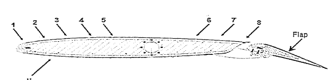


Comments:

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C66: Run # 66

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2022

Run: 67 (P122)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.5	-12.7	-14.6	-15.2
T5	-12.2	-11.8	-12.4	-14.1
TU	-13.3	-13.3	-12.2	-15.3
Time:	2.16	2:26	2:46	2:58

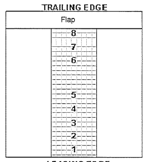
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	29.0	26.5
8	/	28.75	32.5
Flap	/	23.5	29.25
Time:	2:27	2:47	2:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	127	6
3			
4			
5	200	250	12
6			
7			
8	127	150	18
Flap	65	55slush	8
Time:	2.28	2:48	3:00

CYCLE TRACKING

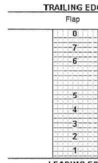
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ___________

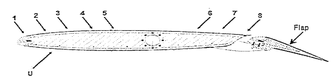


Comments:

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:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C67: Run # 67

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19 2022

Run: 68 (P218)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.5	-12.8	-14.1	-15.4
T5	-12.0	-11.8	-12.2	-14.6
TU	-13.3	-13.2	-11.3	-15.1
Time:	3:18	3:27	3:45	3:58

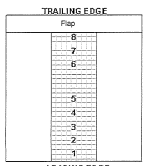
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	29.5	23.75
8	/	26.0	29.0
Flap	/	21.25	29.5
Time:	3:27	3:46	3:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	112	10
3			
4			
5	150	158	10
6			
7			
8	119	127	18
Flap	28	slush30	8
Time:	3:27	3:47	4:00

CYCLE TRACKING

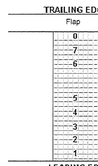
1	2	3	4	hold	time
☑	☑	☐	☐	☐	5 mins
☐	☐	☐	☐	☐	10 mins
☐	☐	☐	☐	☐	15 mins
☐	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ___________

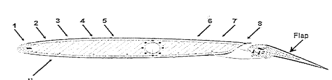


Comments:

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.

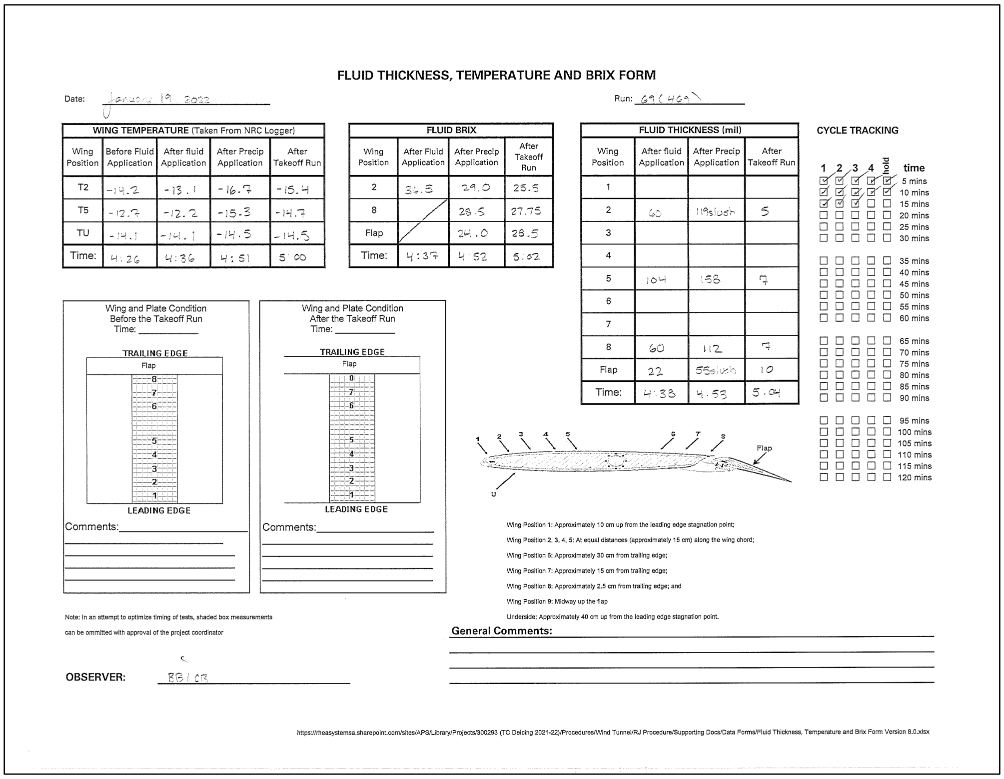
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C68: Run # 68



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19, 2022 Run: 69 (469)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.2	-13.1	-16.7	-15.4
T5	-12.7	-12.2	-15.3	-14.7
TU	-14.1	-14.1	-14.5	-14.5
Time:	4:26	4:36	4:51	5:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	29.0	25.5
8		28.5	27.75
Flap		24.0	28.5
Time:	4:37	4:52	5:02

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	119slush	5
3			
4			
5	104	158	7
6			
7			
8	60	112	7
Flap	22	55slush	10
Time:	4:38	4:53	5:04

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 / CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

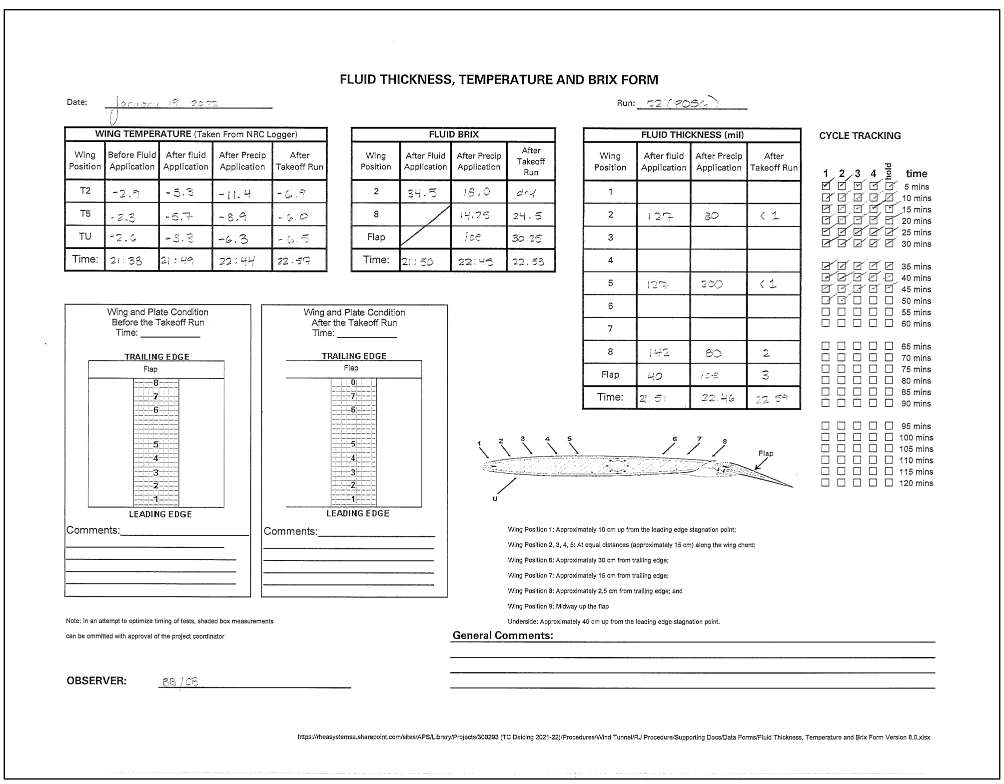
Figure C69: Run # 69

No Data Available

Figure C70: Run # 70

No Data Available

Figure C71: Run # 71



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 19 2022

Run: 72 (POSG)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-2.9	-5.3	-11.4	-6.9
T5	-2.3	-5.7	-8.9	-6.0
TU	-2.6	-3.3	-6.3	-6.5
Time:	21:38	21:49	22:44	22.57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	18.0	dry
8		14.25	24.5
Flap		ice	30.25
Time:	21:50	22:45	22:58

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	80	< 1
3			
4			
5	127	200	< 1
6			
7			
8	142	80	2
Flap	40	102	3
Time:	21:51	22:46	22:59

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: ______

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 C72: Run # 72

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2022 Run: 73 (P204)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.9	-6.4	-11.5	-8.6
T5	-5.0	-6.1	-9.5	-7.8
TU	-5.6	-6.2	-7.6	-8.6
Time:	23:23	23:33	00:16	00:32

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	21.25	24.0
8	/	19.75	23.25
Flap	/	18.0	26.75
Time:	23:34	00:17	00:32

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	119	8
3			
4			
5	142	250	8
6			
7			
8	112	158	16
Flap	40	96 slush	9
Time:	23:35	00:18	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: ____

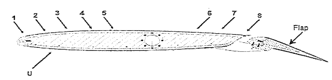
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE

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 C73: Run # 73

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20 2022 Run: 74 (P216)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-8.2	-9.5	-11.2	-10.8
T5	-7.5	-9.3	-9.7	-10.2
TU	-7.9	-9.2	-9.6	-10.7
Time:	00:44	00:53	1:13	1:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	30.0	30.75
8	/	29.75	31.0
Flap	/	28.75	32.25
Time:	00:54	1:14	1:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	119	8
3			
4			
5	158	200	9
6			
7			
8	119	134	14
Flap	35	slush 70	11
Time:	00:55	1:15	1:28

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: ____

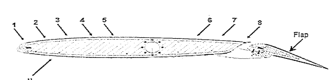
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE

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.

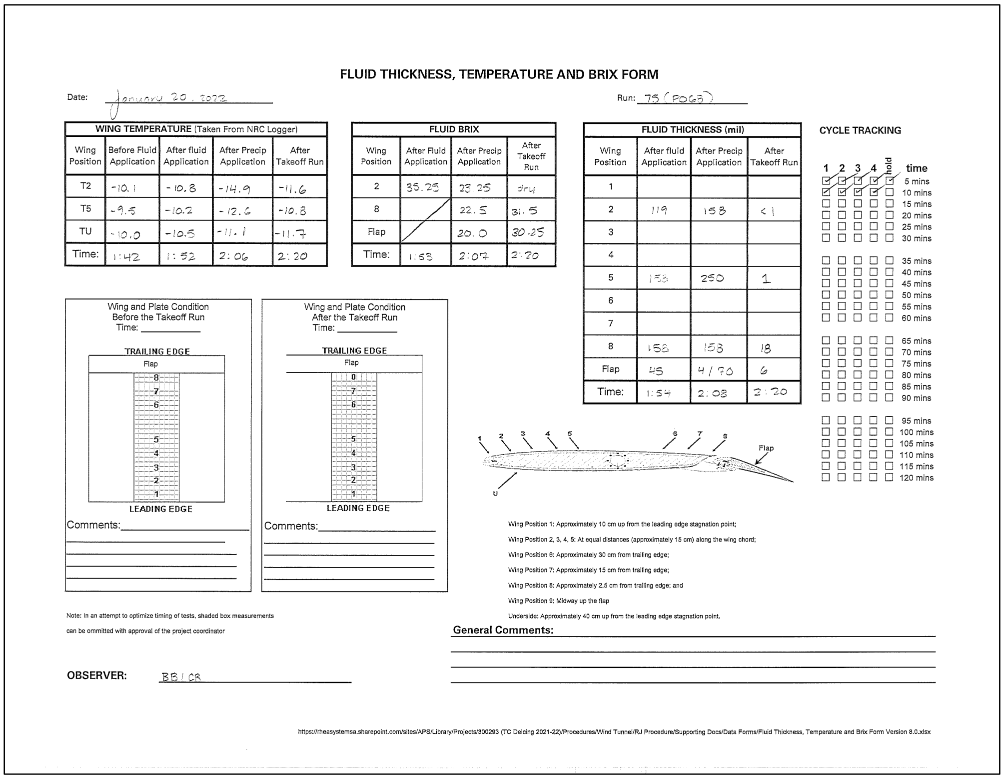
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C74: Run # 74



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2022 Run: 75 (P068)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.1	-10.8	-14.9	-11.6
T5	-9.5	-10.2	-12.6	-10.8
TU	-10.0	-10.5	-11.1	-11.7
Time:	1:42	1:52	2:06	2:20

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.25	23.25	dry
8	/	22.5	31.5
Flap	/	20.0	30.25
Time:	1:53	2:07	2:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	< 1
3			
4			
5	158	250	1
6			
7			
8	158	158	18
Flap	45	4 / 70	6
Time:	1:54	2:08	2:20

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 LEADING EDGE Comments:

Wing and Plate Condition After the Takeoff Run Time: ____ TRAILING EDGE Flap 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

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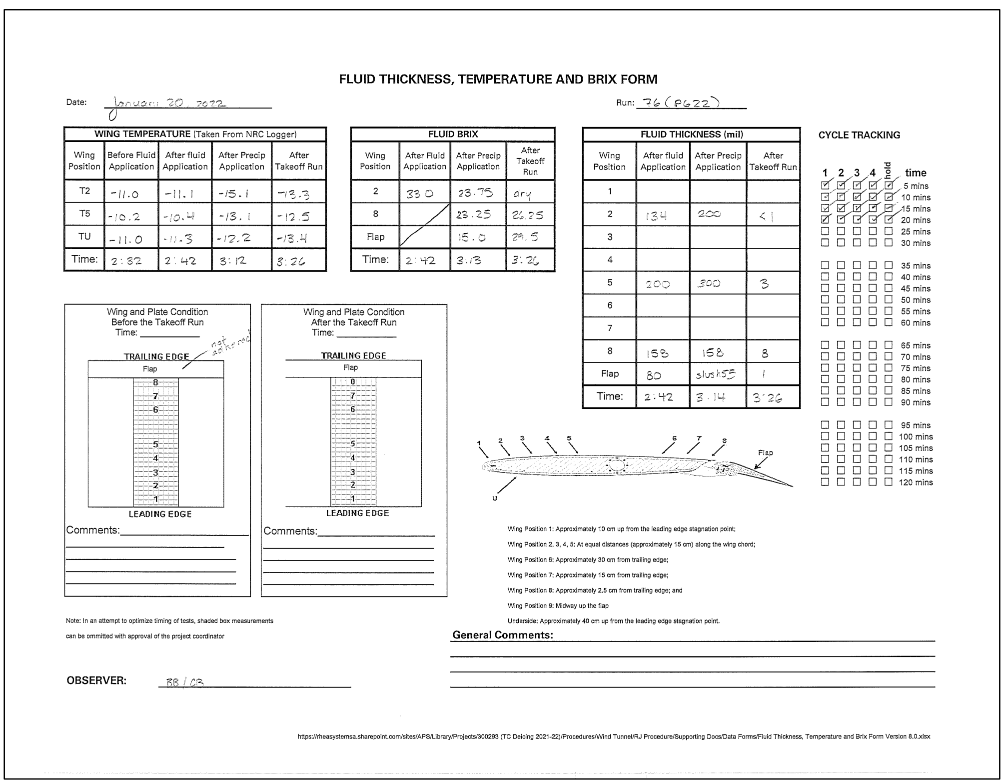
Figure C75: Run # 75



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2022 Run: 76 (P622)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.0	-11.1	-15.1	-13.3
T5	-10.2	-10.4	-13.1	-12.5
TU	-11.0	-11.3	-12.2	-13.4
Time:	2:32	2:42	3:12	3:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	23.75	dry
8	/	23.25	26.25
Flap	/	15.0	29.5
Time:	2:42	3:13	3:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	200	< 1
3			
4			
5	200	300	3
6			
7			
8	158	158	8
Flap	80	slush55	1
Time:	2:42	3:14	3:26

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 (not adhered) LEADING EDGE Comments:

Wing and Plate Condition After the Takeoff Run Time: ____ TRAILING EDGE Flap 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

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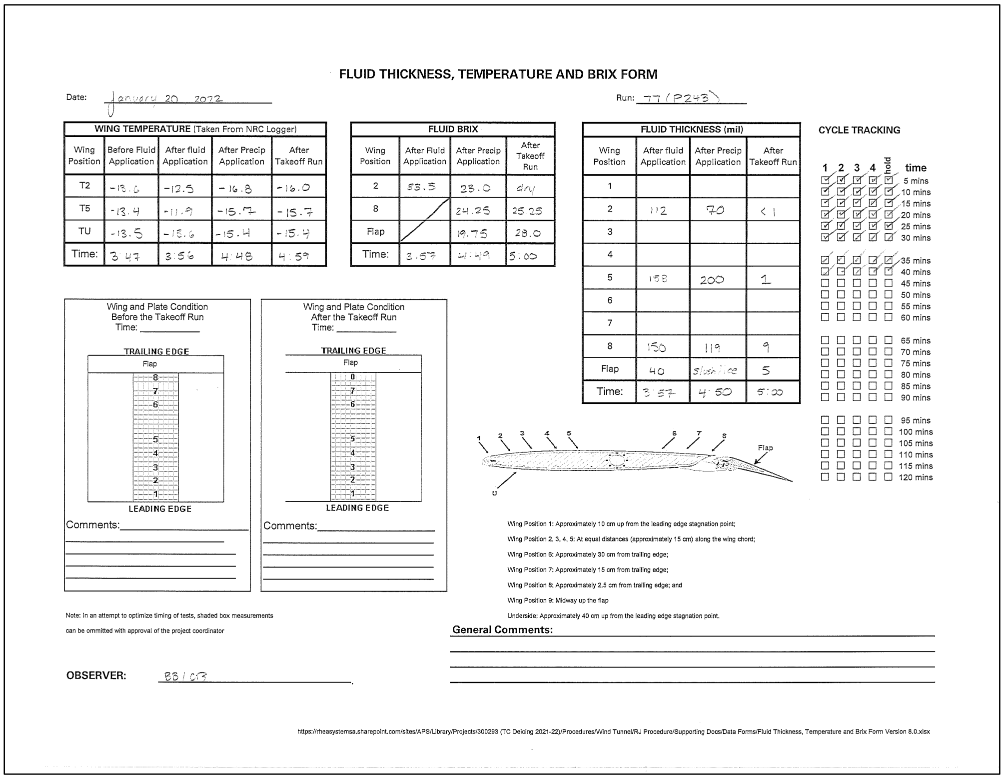
Figure C76: Run # 76



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20 2022

Run: 77 (P243)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.6	-12.5	-16.8	-16.0
T5	-13.4	-11.9	-15.7	-15.7
TU	-13.5	-13.6	-15.4	-15.4
Time:	3:47	3:56	4:48	4:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	23.0	dry
8		24.25	25.25
Flap		19.75	28.0
Time:	3:57	4:49	5:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	70	< 1
3			
4			
5	158	200	1
6			
7			
8	150	119	9
Flap	40	slush/ice	5
Time:	3:57	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 (checked); 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 / CB

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Figure C77: Run # 77

No Data Available

Figure C78: Run # 78

No Data Available

Figure C79: Run # 79

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2022

Run: 80 (P596)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.2	-13.4	-17.4	-17.1
T5	-14.7	-12.8	-15.7	-16.7
TU	-15.0	-13.6	-15.2	-17.3
Time:	21:32	21:41	22:16	22:27

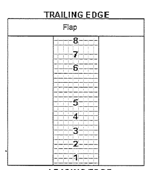
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	28.25	dry
8	/	21.0	29.25
Flap	/	19.5	29.0
Time:	21:42	22:17	22:28

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	158	< 1
3			
4			
5	158	250	3
6			
7			
8	158	158	12
Flap	50	slush 60	9
Time:	21:43	22:18	22:29

CYCLE TRACKING

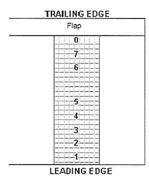
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ________

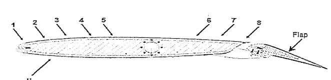


Comments:________________

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C80: Run # 80

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 20, 2022 Run: 81 (P278)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.9	-14.7	-18.5	-18.6
T5	-15.9	-14.2	-17.3	-18.4
TU	-16.3	-16.2	-17.3	-18.3
Time:	22:49	22:57	23:33	23:45

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	23.75	25.25
8	/	22.0	22.75
Flap	/	11.5	25.75
Time:	22:58	23:34	23:46

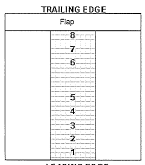
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	134	3
3			
4			
5	119	158	4
6			
7			
8	104	127	4
Flap	24	slush96	4
Time:	22:59	23:35	23:47

CYCLE TRACKING

1 2 3 4 hold time

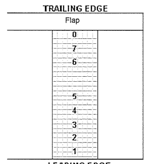
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run Time: ____

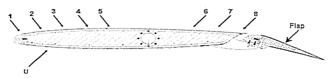


Comments: ____

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: EB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C81: Run # 81

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2022 Run: 82 (P274)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-17.6	-15.9	-19.1	-20.3
T5	-17.5	-15.5	-19.7	-20.3
TU	-17.7	-18.1	-18.7	-20.0
Time:	00:00	00:10	00:37	00:47

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	18.5	25.5
8	/	24.25	25.75
Flap	/	14.5	25.0
Time:	00:10	00:38	00:46

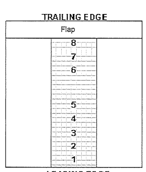
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	200slush	1
3			
4			
5	104	250	5
6			
7			
8	96	158	8
Flap	26	158slush	4
Time:	00:10	00:39	00:49

CYCLE TRACKING

1 2 3 4 hold time

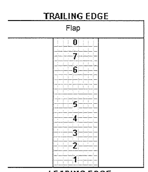
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run Time: ____

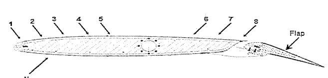


Comments: ____

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.

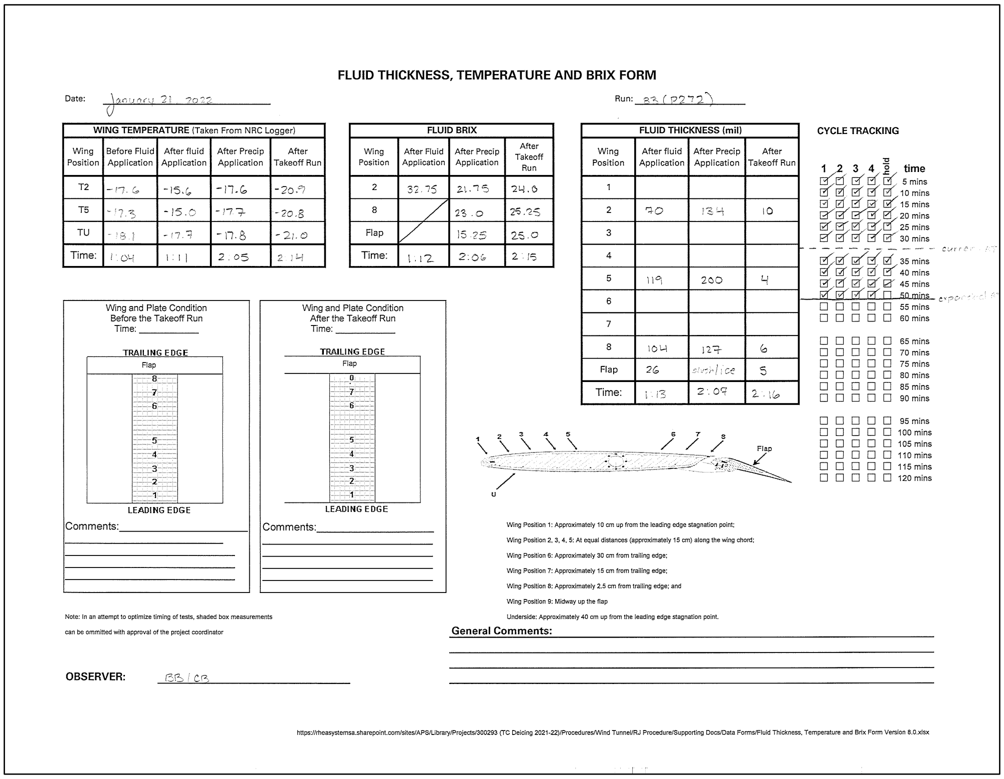
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ____

OBSERVER: EB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C82: Run # 82



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2022 Run: 83 (P272)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-17.6	-15.6	-17.6	-20.9
T5	-17.3	-15.0	-17.7	-20.8
TU	-18.1	-17.7	-17.8	-21.0
Time:	1:04	1:11	2:05	2:14

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	21.75	24.0
8		23.0	25.25
Flap		15.25	25.0
Time:	1:12	2:06	2:15

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	134	10
3			
4			
5	119	200	4
6			
7			
8	104	127	6
Flap	26	slush/ice	5
Time:	1:13	2:07	2:16

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ___ (TRAILING EDGE / Flap / LEADING EDGE)

Wing and Plate Condition After the Takeoff Run Time: ___ (TRAILING EDGE / Flap / LEADING EDGE)

Comments:

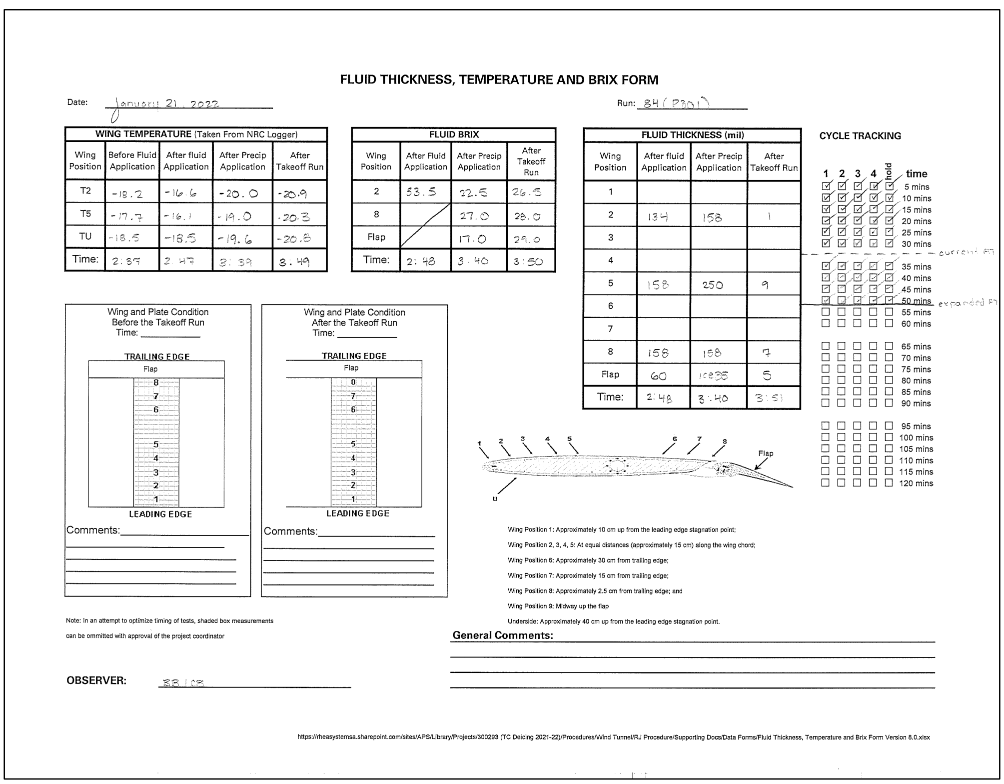
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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 C83: Run # 83



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2022 Run: 84 (P301)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.2	-16.6	-20.0	-20.9
T5	-17.7	-16.1	-19.0	-20.3
TU	-18.5	-18.5	-19.6	-20.8
Time:	2:37	2:47	3:39	3:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	22.5	26.5
8		27.0	28.0
Flap		17.0	29.0
Time:	2:48	3:40	3:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	158	1
3			
4			
5	158	250	9
6			
7			
8	158	158	7
Flap	60	ice35	5
Time:	2:48	3:40	3:51

CYCLE TRACKING

Wing and Plate Condition Before the Takeoff Run Time: ___ (TRAILING EDGE / Flap / LEADING EDGE)

Wing and Plate Condition After the Takeoff Run Time: ___ (TRAILING EDGE / Flap / LEADING EDGE)

Comments:

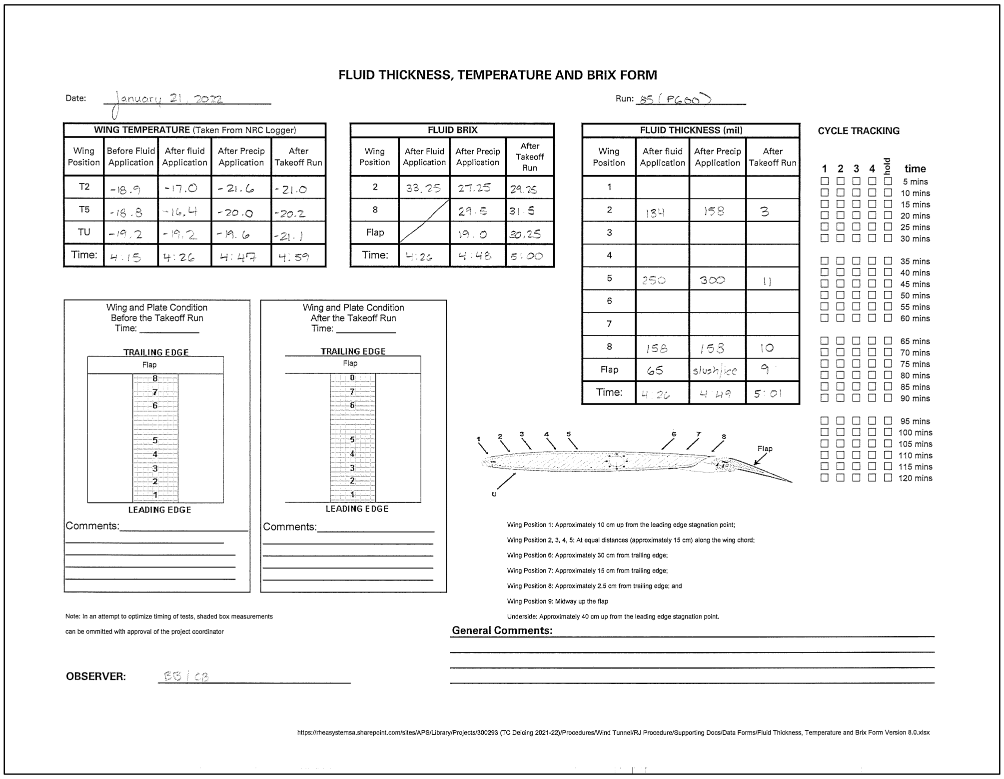
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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 C84: Run # 84



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 21, 2022

Run: 85 (P600)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.9	-17.0	-21.6	-21.0
T5	-18.8	-16.4	-20.0	-20.2
TU	-19.2	-19.2	-19.6	-21.1
Time:	4:15	4:26	4:47	4:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	27.25	29.25
8		29.5	31.5
Flap		19.0	30.25
Time:	4:26	4:48	5:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	158	3
3			
4			
5	250	300	11
6			
7			
8	158	158	10
Flap	65	slush/ice	9
Time:	4:26	4:49	5:01

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: ___

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: BG / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C85: Run # 85

No Data Available

Figure C86: Run # 86

No Data Available

Figure C87: Run # 87

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 23 2022

Run: 88 (PG25)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.8	-13.4	-16.7	-16.1
T5	-13.5	-13.0	-15.7	-15.5
TU	-13.3	-13.1	-14.4	-15.7
Time:	21:37	21:49	22.22	22:56

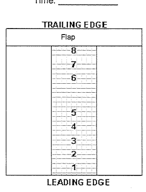
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	19.0	28.75
8	/	21.25	25.25
Flap	/	16.75	26.25
Time:	21:50	22:24	22:37

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	127	1
3			
4			
5	200	250	5
6			
7			
8	158	158	11
Flap	65	slush127	4
Time:	21:51	22:26	22:38

CYCLE TRACKING

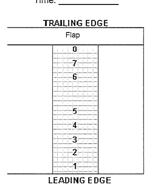
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☐	☐	☐	☐	20 mins
☐	☐	☐	☐	☐	25 mins
☐	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ___________

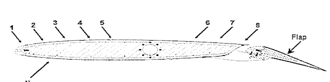


Comments:___________________

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:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C88: Run # 88

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 23, 2022 Run: 89 (P331)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.2	-14.4	-17.5	-16.9
T5	-13.9	-14.1	-16.5	-16.1
TU	-13.9	-14.1	-15.2	-16.3
Time:	22:55	23:05	23:40	23:51

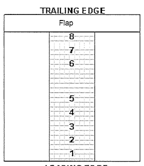
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	21.75	dry
8	/	23.5	25.0
Flap	/	17.0	27.75
Time:	23:06	23:41	23:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	112	134	<1
3			
4			
5	200	250	4
6			
7			
8	142	158	7
Flap	50	slush158	4
Time:	23:07	23:42	23:53

CYCLE TRACKING

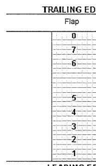
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☐	☐	☐	☐	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ____________

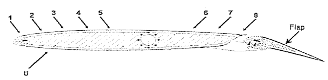


Comments: ____________

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/CR

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Figure C89: Run # 89

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24, 2022 Run: 90 (P654)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.1	-14.8	-18.5	-17.1
T5	-14.7	-14.2	-16.8	-16.6
TU	-14.9	-15.3	-16.4	-16.8
Time:	00:09	00:18	00:51	1:02

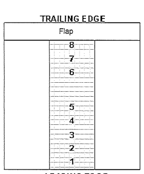
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	22.25	26.0
8	/	23.5	24.25
Flap	/	15.25	27.5
Time:	00:19	00:52	1:03

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	119	3
3			
4			
5	127	200	3
6			
7			
8	80	119	8
Flap	30	slush158	5
Time:	00:20	00:53	1:04

CYCLE TRACKING

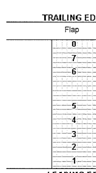
1	2	3	4	hold	time
☑	☑	☑	☑	☑	5 mins
☑	☑	☑	☑	☑	10 mins
☑	☑	☑	☑	☑	15 mins
☑	☑	☑	☑	☑	20 mins
☑	☑	☑	☑	☑	25 mins
☑	☑	☑	☑	☑	30 mins
☐	☐	☐	☐	☐	35 mins
☐	☐	☐	☐	☐	40 mins
☐	☐	☐	☐	☐	45 mins
☐	☐	☐	☐	☐	50 mins
☐	☐	☐	☐	☐	55 mins
☐	☐	☐	☐	☐	60 mins
☐	☐	☐	☐	☐	65 mins
☐	☐	☐	☐	☐	70 mins
☐	☐	☐	☐	☐	75 mins
☐	☐	☐	☐	☐	80 mins
☐	☐	☐	☐	☐	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: ____________

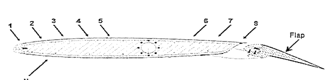


Comments: ____________

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/CR

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C90: Run # 90

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24, 2022 Run: 91 (P303)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.5	-15.1	-20.2	-18.6
T5	-15.0	-14.6	-18.5	-18.0
TU	-15.2	-15.8	-17.7	-18.3
Time:	1:17	1:26	1:50	2:01

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	27.5	25.25
8	/	26.25	27.5
Flap	/	14.75	28.0
Time:	1:27	1:51	2:02

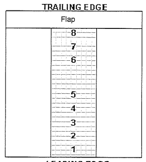
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	158	4
3			
4			
5	200	300	7
6			
7			
8	142	158	7
Flap	65	slush5	8
Time:	1:28	1:52	2:03

CYCLE TRACKING

time	1	2	3	4	hold
5 mins	☑	☑	☑	☑	☑
10 mins	☑	☑	☑	☑	☑
15 mins	☑	☑	☑	☑	☑
20 mins	☑	☑	☑	☐	☐
25 mins – 120 mins	☐	☐	☐	☐	☐

Wing and Plate Condition
Before the Takeoff Run
Time: ________

TRAILING EDGE

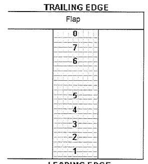


LEADING EDGE

Comments:

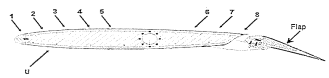
Wing and Plate Condition
After the Takeoff Run
Time: ________

TRAILING EDGE



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: BS / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C91: Run # 91

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24, 2022 Run: 92 (E1)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.9	-15.1	-20.3	-19.5
T5	-15.2	-14.8	-17.2	-19.3
TU	-15.8	-15.7	-17.0	-19.0
Time:	2:25	2:35	2:56	3:07

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	19.75	24.5
8	/	22.5	24.5
Flap	/	12.25	27.75
Time:	2:36	2:57	3:08

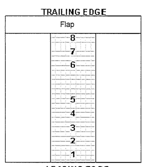
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	1
3			
4			
5	200	250	3
6			
7			
8	150	158	8
Flap	40	slush200	6
Time:	2:37	2:58	3:09

CYCLE TRACKING

time	1	2	3	4	hold
5 mins	☑	☑	☑	☑	☑
10 mins	☑	☑	☑	☑	☑
15 mins	☑	☑	☑	☑	☑
20 mins – 120 mins	☐	☐	☐	☐	☐

Wing and Plate Condition
Before the Takeoff Run
Time: ________

TRAILING EDGE

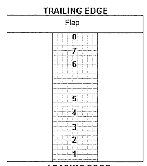


LEADING EDGE

Comments:

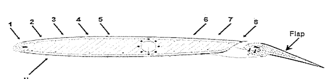
Wing and Plate Condition
After the Takeoff Run
Time: ________

TRAILING EDGE



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.

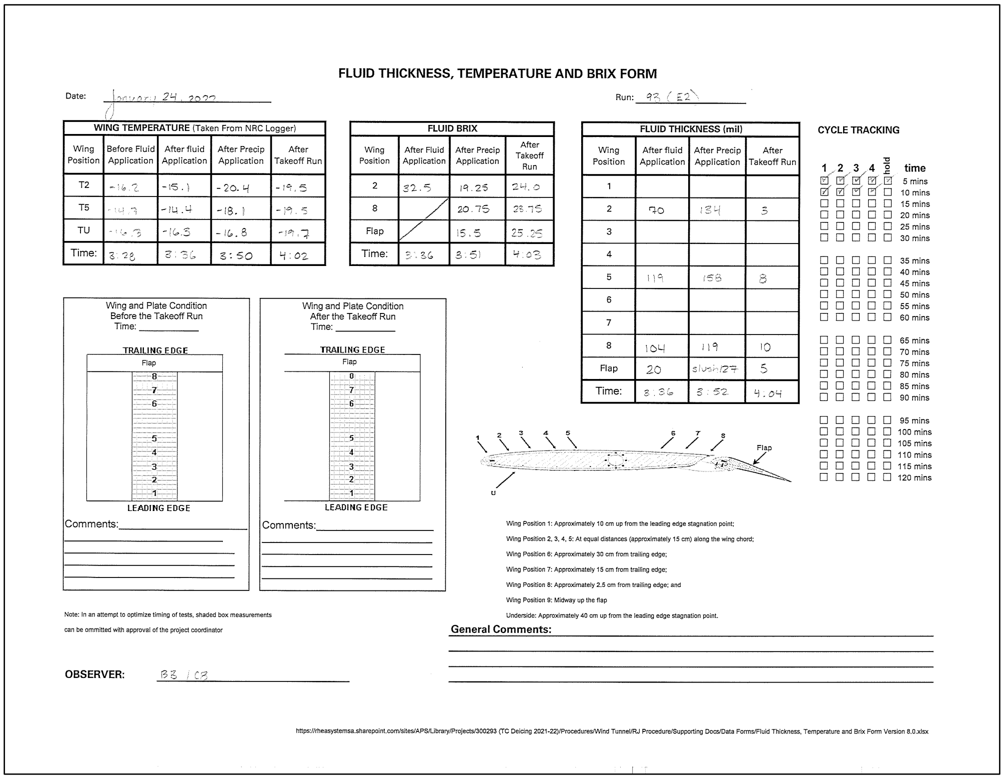
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C92: Run # 92



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24, 2022 Run: 93 (E2)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.2	-15.1	-20.4	-19.5
T5	-14.7	-14.4	-18.1	-19.5
TU	-16.3	-16.3	-16.8	-19.7
Time:	3:28	3:36	3:50	4:02

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	19.25	24.0
8	/	20.75	23.75
Flap	/	15.5	25.25
Time:	3:36	3:51	4:03

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	134	3
3			
4			
5	119	158	8
6			
7			
8	104	119	10
Flap	20	slush/27	5
Time:	3:36	3:52	4:04

CYCLE TRACKING

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.

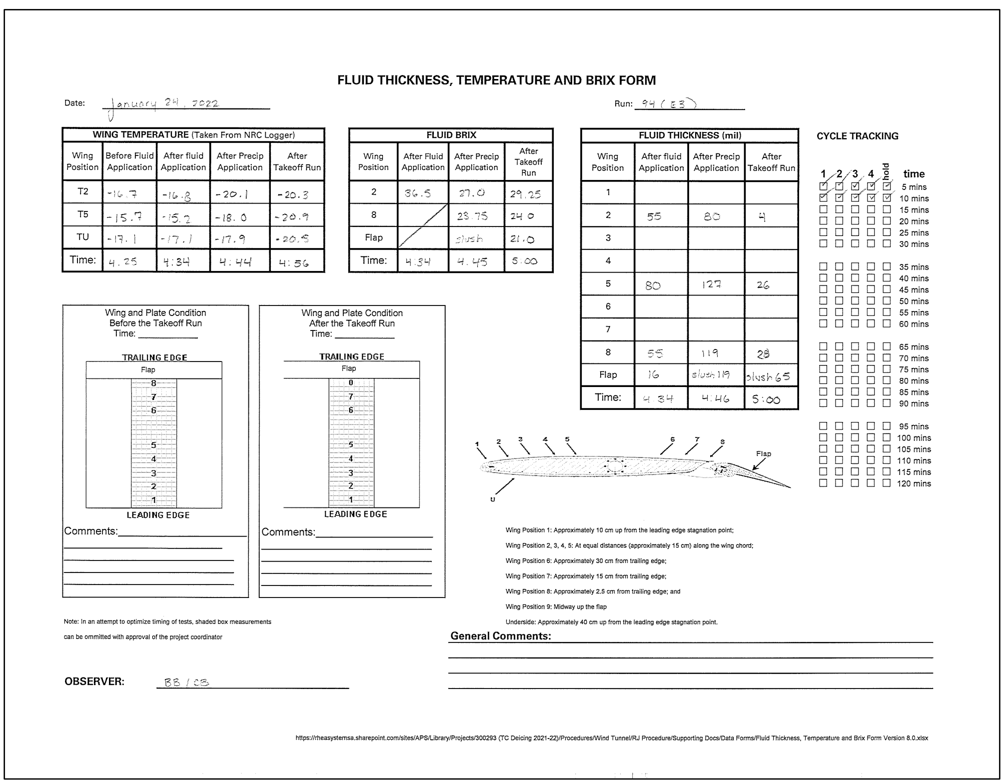
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C93: Run # 93



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24, 2022 Run: 94 (E3)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.7	-16.8	-20.1	-20.3
T5	-15.7	-15.2	-18.0	-20.9
TU	-17.1	-17.1	-17.9	-20.5
Time:	4.25	4:34	4:44	4:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	27.0	29.25
8	/	23.75	24.0
Flap	/	slush	21.0
Time:	4:34	4.45	5:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	80	4
3			
4			
5	80	127	26
6			
7			
8	55	119	28
Flap	16	slush 119	slush 65
Time:	4 34	4:46	5:00

CYCLE TRACKING

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C94: Run # 94

No Data Available

Figure C95: Run # 95

No Data Available

Figure C96: Run # 96

No Data Available

Figure C97: Run # 97

No Data Available

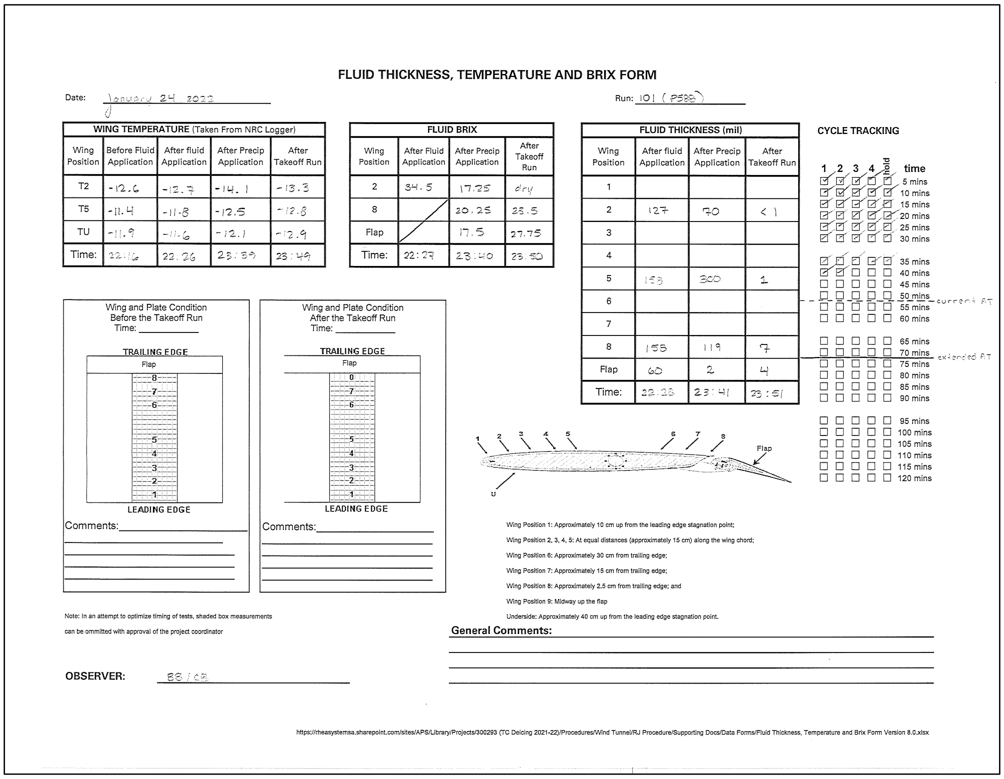
Figure C98: Run # 98

No Data Available

Figure C99: Run # 99

No Data Available

Figure C100: Run # 100



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 24 2022 Run: 101 (P588)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.6	-12.7	-14.1	-13.3
T5	-11.4	-11.8	-12.5	-12.8
TU	-11.9	-11.6	-12.1	-12.9
Time:	22:16	22:26	23:39	23:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	17.25	dry
8		20.25	23.5
Flap		17.5	27.75
Time:	22:27	23:40	23:50

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	127	70	< 1
3			
4			
5	158	300	1
6			
7			
8	155	119	7
Flap	60	2	4
Time:	22:28	23:41	23:51

CYCLE TRACKING (1, 2, 3, 4, hold; time 5 mins – 120 mins; current AT at 50 mins; extended AT at 70 mins)

Wing and Plate Condition Before the Takeoff Run Time:

Wing and Plate Condition After the Takeoff Run Time:

TRAILING EDGE / Flap / 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.

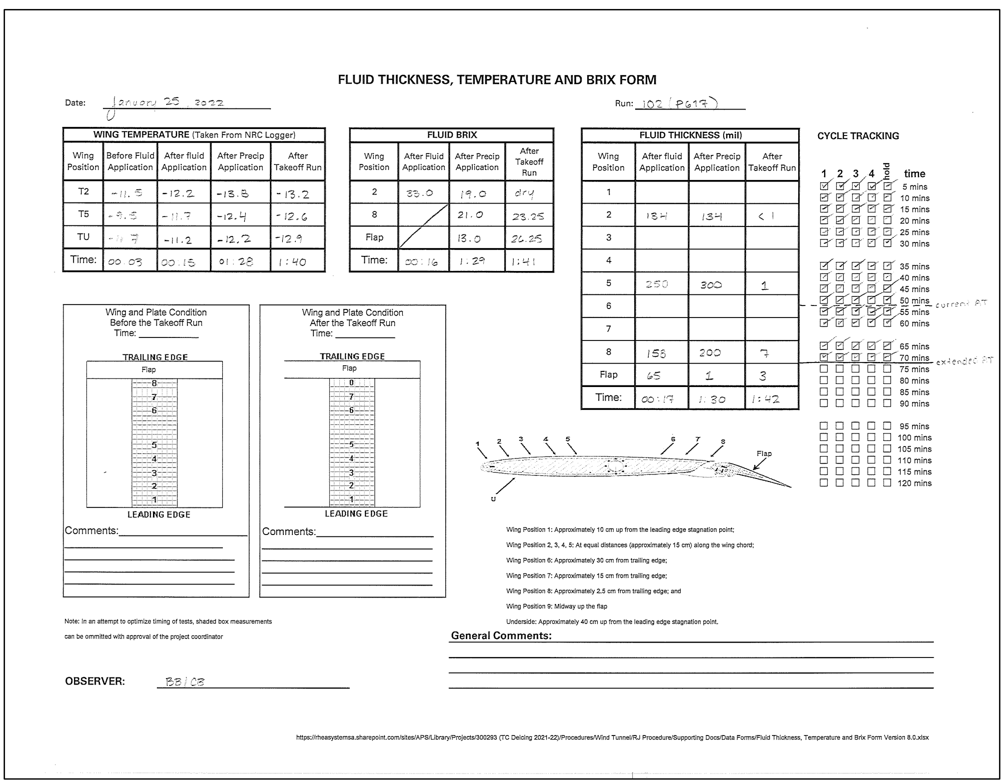
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C101: Run # 101



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2022 Run: 102 (P617)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.5	-12.2	-13.8	-13.2
T5	-9.5	-11.7	-12.4	-12.6
TU	-11.7	-11.2	-12.2	-12.9
Time:	00:03	00:15	01:28	1:40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	19.0	dry
8		21.0	23.25
Flap		13.0	26.25
Time:	00:16	1:29	1:41

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	134	< 1
3			
4			
5	250	300	1
6			
7			
8	158	200	7
Flap	65	1	3
Time:	00:17	1:30	1:42

CYCLE TRACKING (1, 2, 3, 4, hold; time 5 mins – 120 mins; current AT at 50 mins; extended AT at 70 mins)

Wing and Plate Condition Before the Takeoff Run Time:

Wing and Plate Condition After the Takeoff Run Time:

TRAILING EDGE / Flap / 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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C102: Run # 102

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25 2022 Run: 103 (P646)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-11.6	-12.2	-12.7	-12.5
T5	-10.2	-12.0	-12.5	-11.6
TU	-11.6	-11.8	-11.4	-12.7
Time:	1:55	2:03	3:15	3:28

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	14.75	dry
8	/	19.75	22.0
Flap	/	dry/11.0	24.75
Time:	2:04	3:16	3:29

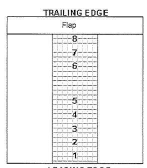
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	127	< 1
3			
4			
5	142	250	1
6			
7			
8	104	150	8
Flap	28	< 1	3
Time:	2:05	3:17	3:30

CYCLE TRACKING

1 2 3 4 hold time

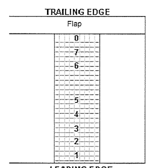
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ________

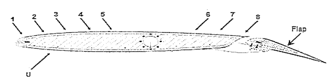


Comments: ________

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: ________

OBSERVER: BB/CB

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Figure C103: Run # 103

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25 2022 Run: 104 (P211)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-10.1	-11.7	-12.9	-12.8
T5	-8.4	-11.4	-11.9	-12.3
TU	-10.0	-10.9	-11.3	-13.1
Time:	3.59	4:08	4:42	4:53

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	27.0	28.25
8	/	28.0	29.25
Flap	/	18.75	28.5
Time:	4.09	4:44	4:54

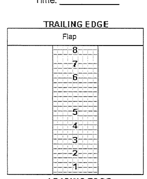
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	127	9
3			
4			
5	150	200	9
6			
7			
8	96	127	14
Flap	35	65	9
Time:	4:10	4:46	4:55

CYCLE TRACKING

1 2 3 4 hold time

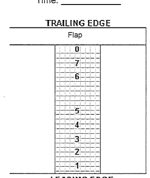
5 mins, 10 mins, 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ________

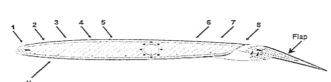


Comments: ________

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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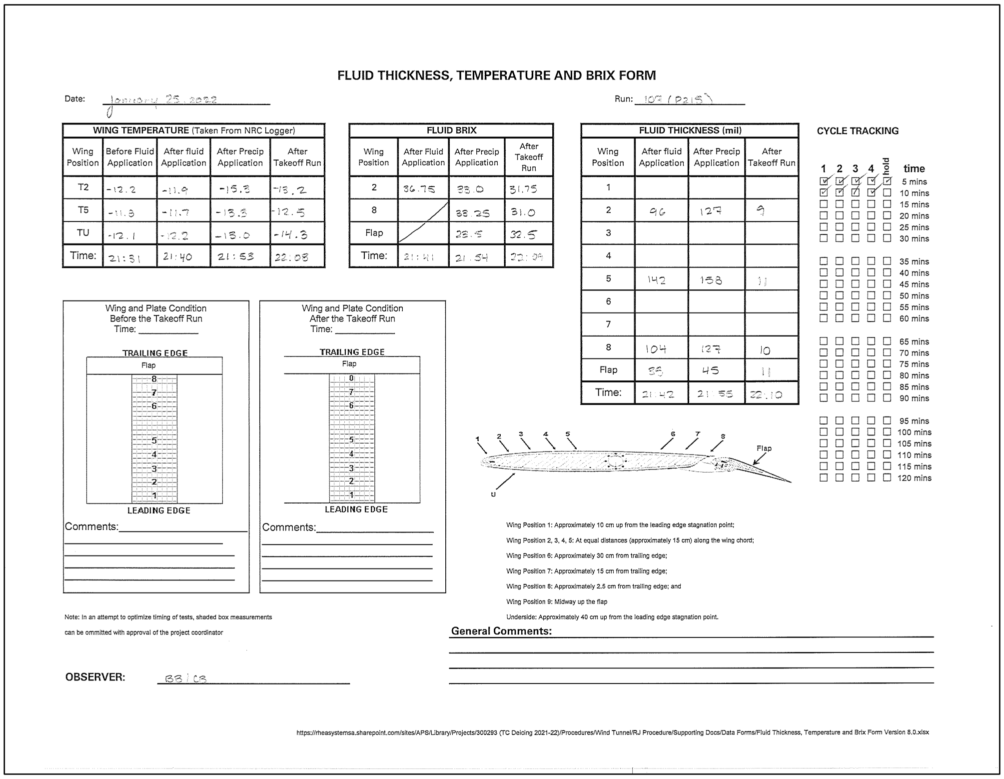
Figure C104: Run # 104

No Data Available

Figure C105: Run # 105

No Data Available

Figure C106: Run # 106



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2022 Run: 107 (P219)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.2	-11.9	-15.3	-13.2
T5	-11.8	-11.7	-13.3	-12.5
TU	-12.1	-12.2	-13.0	-14.3
Time:	21:31	21:40	21:53	22:08

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	33.0	31.75
8	/	38.25	31.0
Flap	/	28.5	32.5
Time:	21:41	21:54	22:09

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	9
3			
4			
5	142	158	11
6			
7			
8	104	127	10
Flap	35	45	11
Time:	21:42	21:55	22:10

CYCLE TRACKING

1 2 3 4 hold time

5 mins (1, 2, 3, 4, hold checked); 10 mins (1, 2, 3, 4 checked); 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.

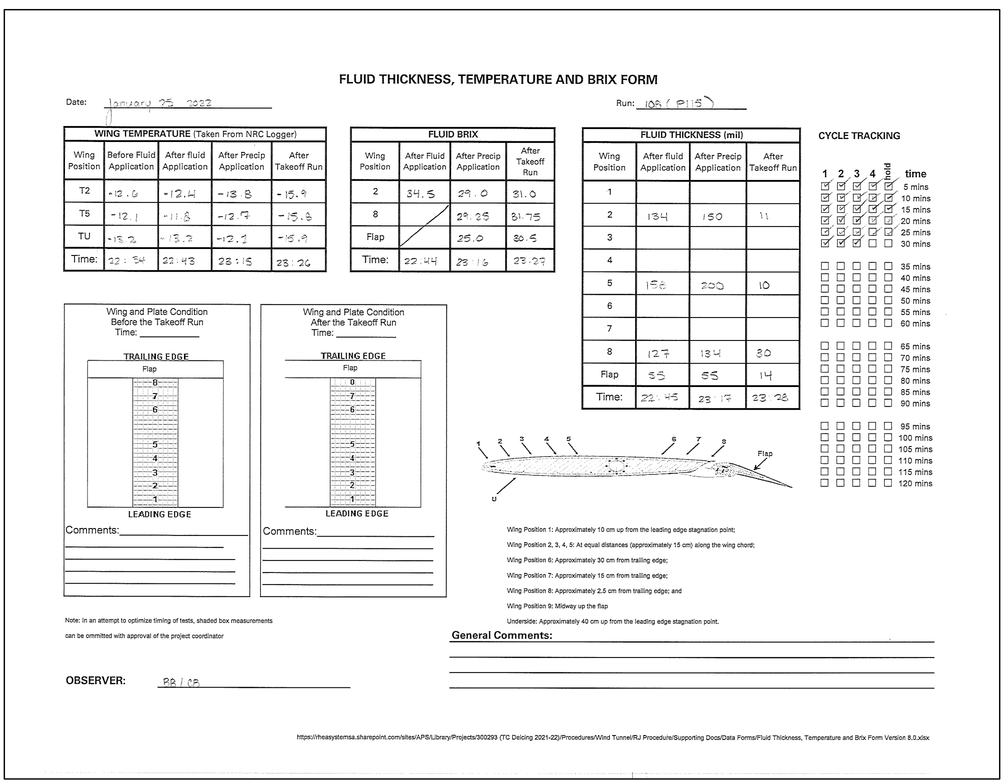
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C107: Run # 107



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 25, 2022 Run: 108 (P115)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.6	-12.4	-13.8	-15.9
T5	-12.1	-11.8	-12.7	-15.8
TU	-13.2	-13.3	-12.1	-15.9
Time:	22:34	22:43	23:15	23:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.5	29.0	31.0
8	/	29.25	31.75
Flap	/	25.0	30.5
Time:	22:44	23:16	23:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	150	11
3			
4			
5	158	200	10
6			
7			
8	127	134	30
Flap	55	55	14
Time:	22:45	23:17	23:28

CYCLE TRACKING

1 2 3 4 hold time

5 mins, 10 mins, 15 mins, 20 mins, 25 mins (1, 2, 3, 4, hold checked); 30 mins (1, 2, 3 checked); 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.

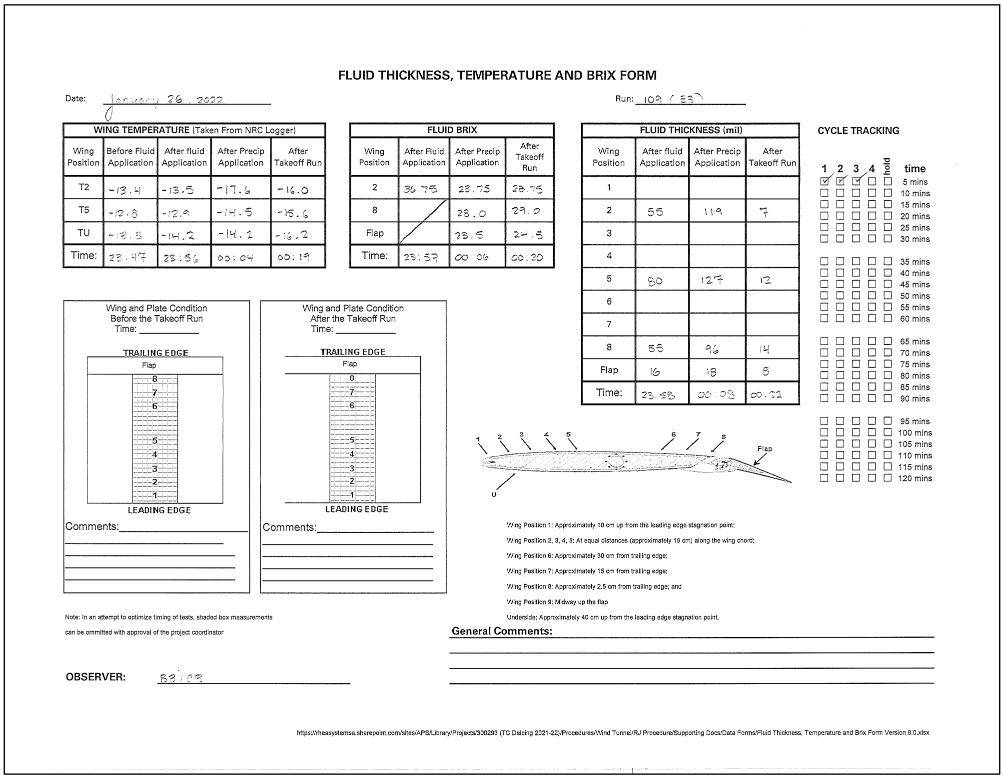
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C108: Run # 108



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022 Run: 109 (E3)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.4	-13.5	-17.6	-16.0
T5	-12.8	-12.9	-14.5	-15.6
TU	-13.8	-14.2	-14.1	-16.2
Time:	23:47	23:56	00:04	00:19

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	23.75	28.75
8	/	28.0	29.0
Flap	/	23.5	24.5
Time:	23:57	00:06	00:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	119	7
3			
4			
5	80	127	12
6			
7			
8	56	96	14
Flap	16	18	8
Time:	23:58	00:08	00:21

CYCLE TRACKING (1 2 3 4 hold; time 5 mins – 120 mins)

Wing and Plate Condition Before the Takeoff Run Time: ______

Wing and Plate Condition After the Takeoff Run Time: ______

Comments:

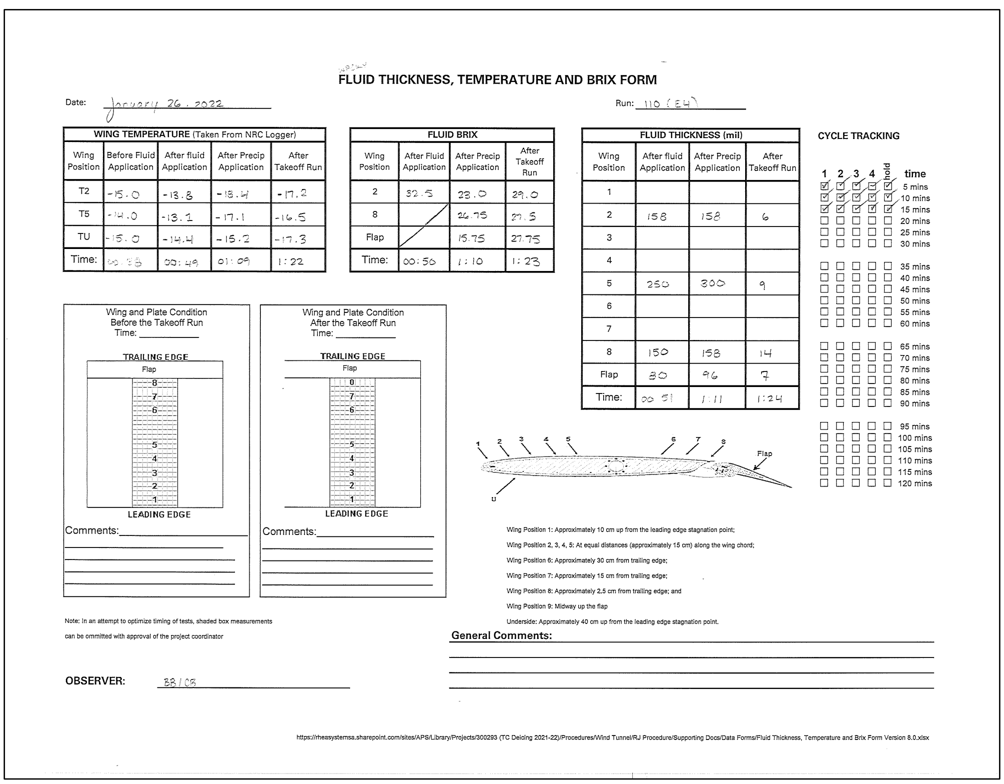
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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

Figure C109: Run # 109



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022 Run: 110 (E4)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.0	-13.8	-18.4	-17.2
T5	-14.0	-13.1	-17.1	-16.5
TU	-15.0	-14.4	-15.2	-17.3
Time:	00:38	00:49	01:09	1:22

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.5	23.0	29.0
8	/	26.75	27.5
Flap	/	15.75	27.75
Time:	00:50	1:10	1:23

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	158	158	6
3			
4			
5	250	300	9
6			
7			
8	150	158	14
Flap	80	96	7
Time:	00:51	1:11	1:24

CYCLE TRACKING (1 2 3 4 hold; time 5 mins – 120 mins)

Wing and Plate Condition Before the Takeoff Run Time: ______

Wing and Plate Condition After the Takeoff Run Time: ______

Comments:

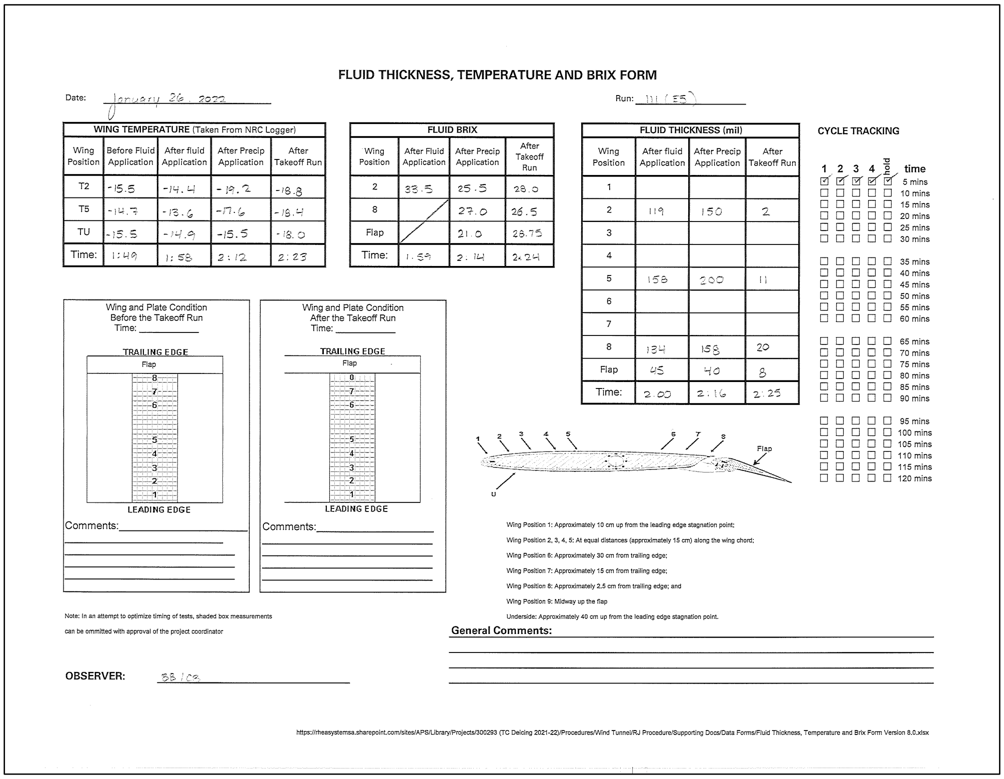
Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 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

Figure C110: Run # 110



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022

Run: 111 (E5)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.5	-14.4	-19.2	-18.8
T5	-14.7	-13.6	-17.6	-18.4
TU	-15.5	-14.9	-15.5	-18.0
Time:	1:49	1:58	2:12	2:23

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	25.5	28.0
8	/	27.0	26.5
Flap	/	21.0	28.75
Time:	1:59	2:14	2:24

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	150	2
3			
4			
5	158	200	11
6			
7			
8	134	158	20
Flap	45	40	8
Time:	2:00	2:16	2:25

CYCLE TRACKING

1 2 3 4 hold time

5 mins (1, 2, 3, 4, hold checked); 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.

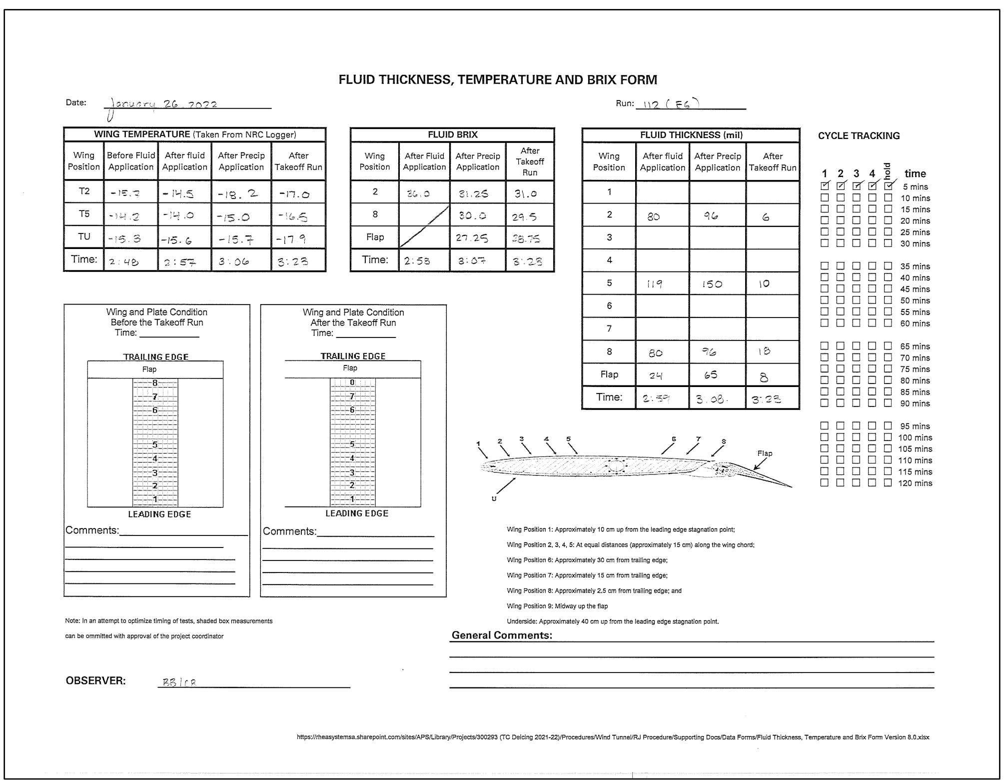
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C111: Run # 111



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022

Run: 112 (E6)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.7	-14.5	-18.2	-17.0
T5	-14.2	-14.0	-15.0	-16.5
TU	-15.3	-15.6	-15.7	-17.9
Time:	2:48	2:57	3:06	3:23

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	31.25	31.0
8	/	30.0	29.5
Flap	/	27.25	28.75
Time:	2:58	3:07	3:23

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	96	6
3			
4			
5	119	150	10
6			
7			
8	80	96	18
Flap	24	65	8
Time:	2:59	3:08	3:23

CYCLE TRACKING

1 2 3 4 hold time

5 mins (1, 2, 3, 4, hold checked); 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.

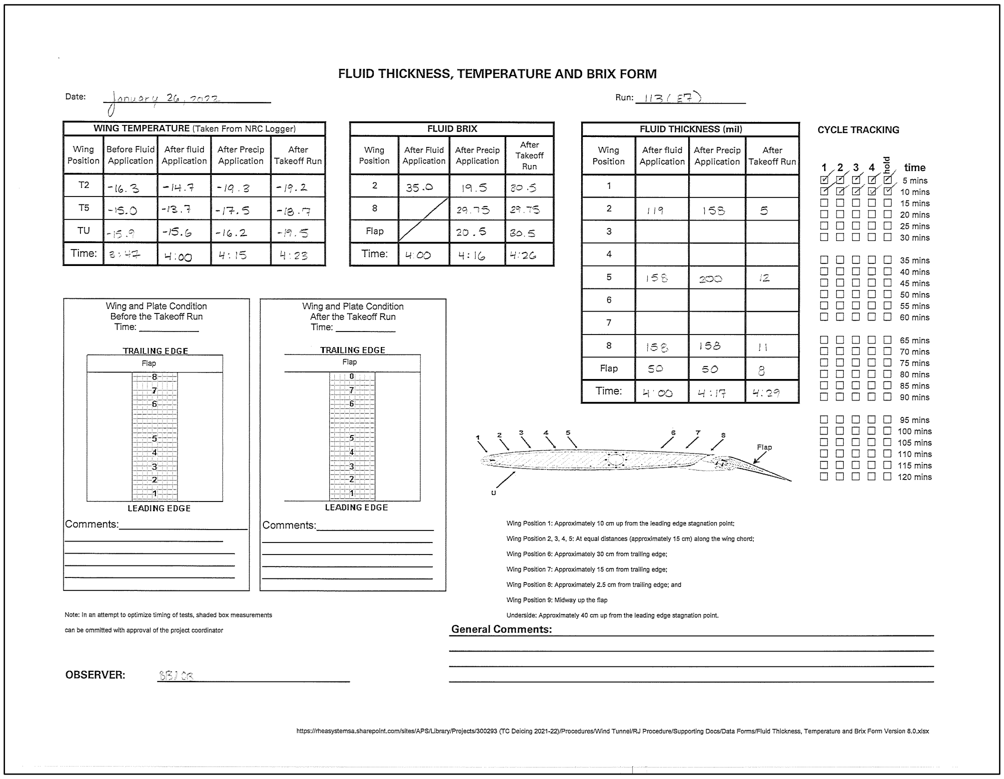
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments:

OBSERVER: BB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C112: Run # 112



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022

Run: 113 (E7)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.3	-14.7	-19.3	-19.2
T5	-15.0	-13.7	-17.5	-18.7
TU	-15.9	-15.6	-16.2	-19.5
Time:	3:47	4:00	4:15	4:23

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	19.5	30.5
8	/	29.75	29.75
Flap	/	20.5	30.5
Time:	4:00	4:16	4:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	5
3			
4			
5	158	200	12
6			
7			
8	158	158	11
Flap	50	50	8
Time:	4:00	4:17	4:29

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: SS/CR

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Figure C113: Run # 113

No Data Available

Figure C114: Run # 114

No Data Available

Figure C115: Run # 115

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022

Run: 116 (E1)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.2	-14.9	-19.7	-17.8
T5	-15.1	-13.9	-16.9	-17.0
TU	-15.3	-15.3	-15.7	-18.3
Time:	21:37	21:50	22:03	22:16

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.5	21.25	27.5
8	/	18.75	25.75
Flap	/	17.75	29.0
Time:	21:50	22.04	22:16

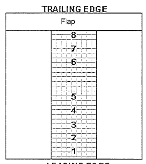
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	2
3			
4			
5	158	200	6
6			
7			
8	142	158	11
Flap	145	50	6
Time:	21.50	22.05	22.16

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

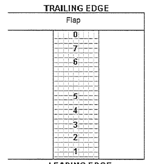


LEADING EDGE

Comments:___________

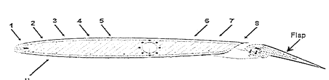
Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE



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: BR | CR

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Figure C116: Run # 116

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 26, 2022 Run: 117 (E9)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-16.2	-15.5	-19.6	-17.8
T5	-14.5	-14.6	-16.2	-17.4
TU	-16.2	-16.3	-16.3	-18.9
Time:	22:34	22:41	22:50	23:04

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	30.75	31.0
8	/	24.5	28.0
Flap	/	15.5	31.25
Time:	22:42	22:51	23:04

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	50	80	8
3			
4			
5	70	119	9
6			
7			
8	50	70	18
Flap	14	slush	6
Time:	22:43	22:52	23:04

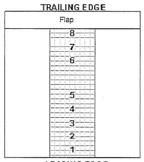
CYCLE TRACKING

1 2 3 4 hold time

5 mins (1, 2, 3, 4 checked), 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

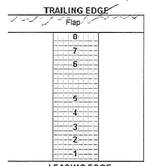


LEADING EDGE

Comments: ______

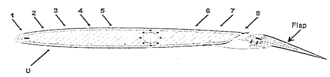
Wing and Plate Condition After the Takeoff Run
Time: ______ not adhered

TRAILING EDGE



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: SB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C117: Run # 117

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022 Run: 118 (P597)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-17.4	-16.3	-20.6	-20.5
T5	-15.9	-15.6	-18.7	-19.9
TU	-17.0	-16.9	-17.5	-20.8
Time:	23:22	23:33	23:54	00:06

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	28.5	28.25
8	/	29.25	30.75
Flap	/	19.75	29.5
Time:	23:33	23:55	00:07

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	158	4
3			
4			
5	200	250	7
6			
7			
8	119	158	12
Flap	65	28	9
Time:	23:33	23:56	00:08

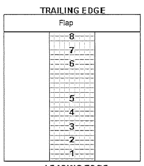
CYCLE TRACKING

1 2 3 4 hold time

5 mins (checked), 10 mins (checked), 15 mins (checked), 20 mins (checked), 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

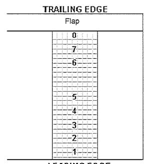


LEADING EDGE

Comments: ______

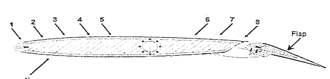
Wing and Plate Condition After the Takeoff Run
Time: ______

TRAILING EDGE



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: SB/CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C118: Run # 118

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022 Run: 119 (P597)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.3	-17.2	-20.7	-19.5
T5	-16.4	-15.9	-18.7	-18.5
TU	-17.7	-17.6	-18.2	-20.3
Time:	00:29	00:41	00:56	1:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.0	26.0	29.75
8		31.75	30.5
Flap		17.75	31.0
Time:	00:41	00:57	1:13

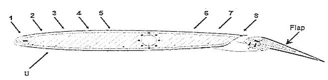
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	158	3
3			
4			
5	200	250	12
6			
7			
8	127	200	14
Flap	55	50	7
Time:	00:41	00:58	1:14

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C119: Run # 119

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022 Run: 120 (P597)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.6	-17.7	-20.4	-20.3
T5	-16.7	-16.6	-18.3	-20.0
TU	-17.7	-18.0	-18.1	-20.7
Time:	1:41	1:49	2:02	2:15

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.75	29.5	31.0
8		31.5	33.0
Flap		24.0	31.5
Time:	1:50	2:03	2:16

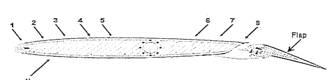
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	142	158	6
3			
4			
5	200	250	7
6			
7			
8	158	158	9
Flap	55	45	9
Time:	1:51	2:04	2:17

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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C120: Run # 120

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022 Run: 121 (P099)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.3	-17.1	-20.6	-19.9
T5	-16.3	-15.9	-18.2	-19.2
TU	-17.8	-17.9	-18.4	-19.9
Time:	2:35	2:50	3:01	3:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	27.0	30.0
8	/	28.25	30.0
Flap	/	24.75	30.0
Time:	2:49	3:02	3:13

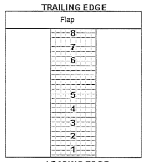
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	150	158	8
3			
4			
5	200	300	9
6			
7			
8	158	158	11
Flap	70	80	9
Time:	2:49	3:03	3:14

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

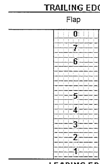


LEADING EDGE

Comments:

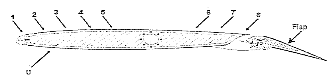
Wing and Plate Condition After the Takeoff Run
Time: ___________

TRAILING EDGE



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: RB / CB

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Figure C121: Run # 121

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022 Run: 122 (P19GA)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-17.5	-17.0	-21.6	-19.4
T5	-15.5	-15.9	-18.7	-18.7
TU	-17.3	-17.5	-17.7	-19.2
Time:	3:27	3.36	3:48	3:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	26.5	29.0
8	/	27.25	28.5
Flap	/	24.75	30.25
Time:	3:37	3:49	4:00

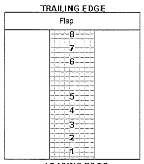
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	134	5
3			
4			
5	142	200	5
6			
7			
8	96	134	10
Flap	35	65 slush	6
Time:	3:38	3:50	4:01

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: ___________

TRAILING EDGE

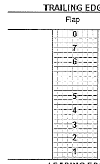


LEADING EDGE

Comments:

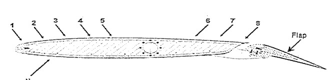
Wing and Plate Condition After the Takeoff Run
Time: ___________

TRAILING EDGE



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: RB / CB

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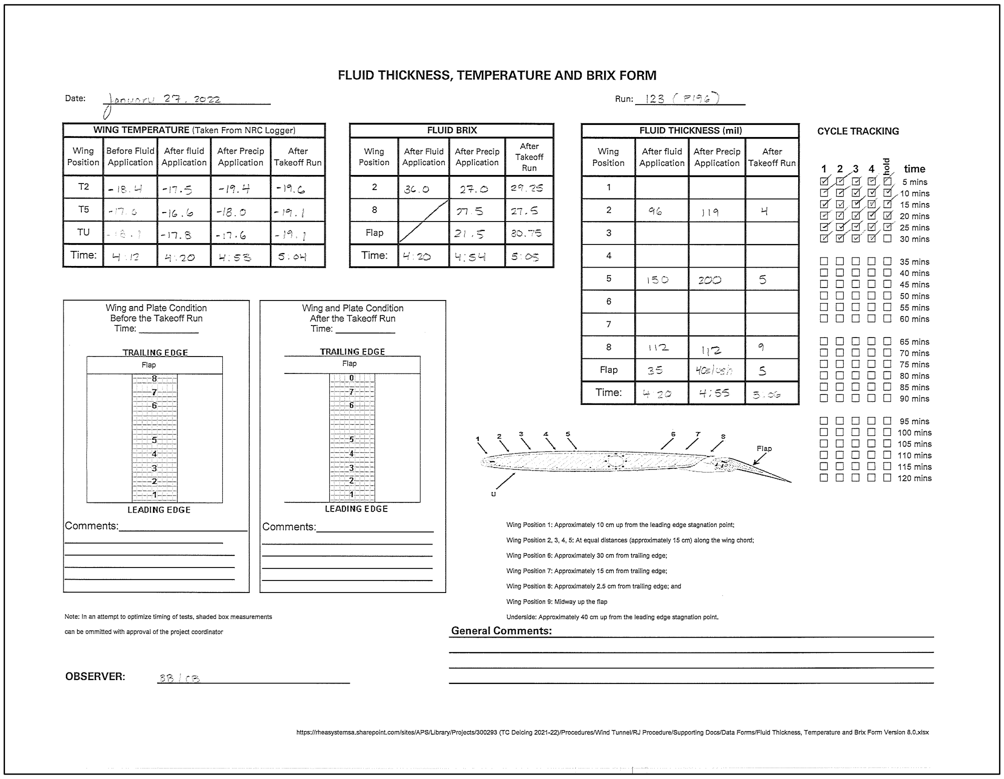
Figure C122: Run # 122



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022

Run: 123 (F196)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.4	-17.5	-19.4	-19.6
T5	-17.0	-16.6	-18.0	-19.1
TU	-18.1	-17.8	-17.6	-19.1
Time:	4:12	4:20	4:53	5:04

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.0	27.0	29.25
8	/	27.5	27.5
Flap	/	21.5	30.75
Time:	4:20	4:54	5:05

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	119	4
3			
4			
5	150	200	5
6			
7			
8	112	112	9
Flap	35	40=lush	5
Time:	4:20	4:55	5:06

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: SB / CB

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

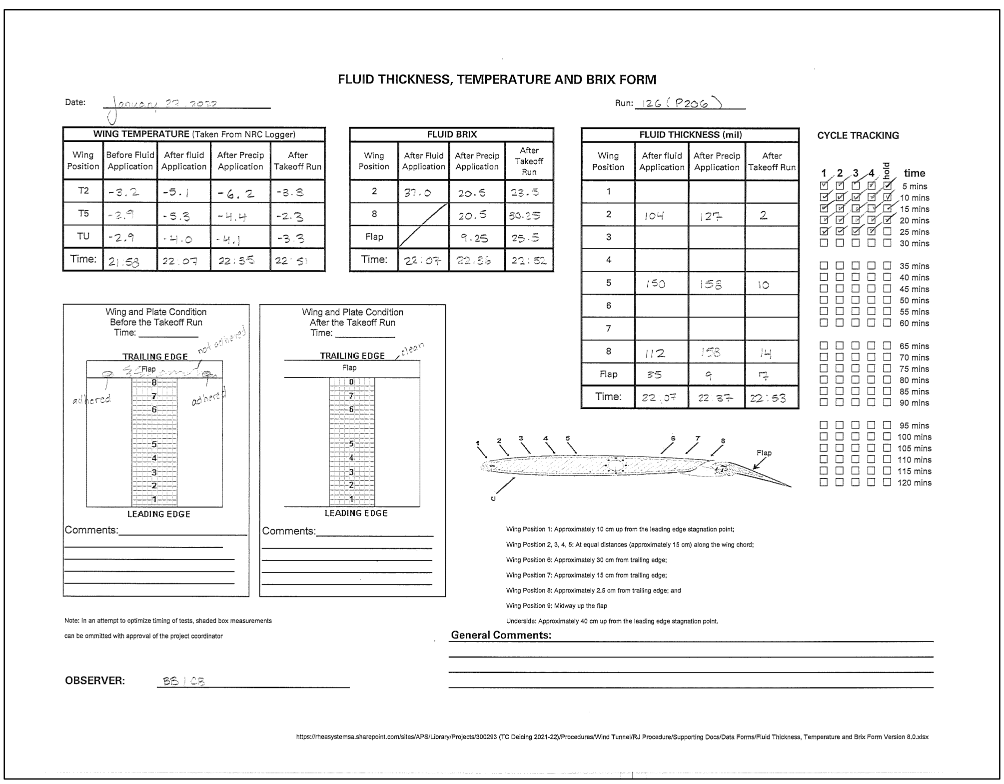
Figure C123: Run # 123

No Data Available

Figure C124: Run # 124

No Data Available

Figure C125: Run # 125



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 27, 2022

Run: 126 (P206)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.2	-5.1	-6.2	-3.3
T5	-2.9	-5.3	-4.4	-2.3
TU	-2.9	-4.0	-4.1	-3.3
Time:	21:58	22:07	22:55	22:51

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.0	20.5	23.5
8	/	20.5	30.25
Flap	/	9.25	25.5
Time:	22:07	22:36	22:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	127	2
3			
4			
5	150	158	10
6			
7			
8	112	158	14
Flap	35	9	17
Time:	22:07	22:37	22:53

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
adhered / not adhered / adhered
Comments: ______

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
clean
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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C126: Run # 126

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28 2022 Run: 127 (P084)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.3	-5.5	-6.9	-4.1
T5	-2.9	-5.7	-6.2	-3.0
TU	-3.3	-4.0	-4.8	-3.7
Time:	23:58	00:11	00:57	1:10

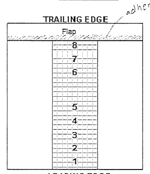
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.75	15.25	dry
8	/	11.0	22.5
Flap	/	ice	dry
Time:	00:12	00:58	1:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	158	150	< 1
3			
4			
5	200	200	< 1
6			
7			
8	158	158	12
Flap	65	ice	< 1
Time:	00:13	00:58	1:10

CYCLE TRACKING

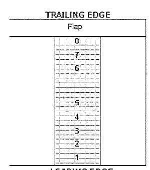
1 2 3 4 hold time
5 mins (checked 1–4, hold), 10 mins (checked 1–4, hold), 15 mins, 20 mins, 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115 mins, 120 mins

Wing and Plate Condition Before the Takeoff Run
Time: ___________

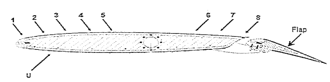


Comments: ___________

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 / CS

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C127: Run # 127

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28 2022 Run: 128 (E9)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.5	-5.6	-6.7	-5.9
T5	-2.8	-6.0	-4.8	-5.3
TU	-3.4	-4.2	-4.0	-6.1
Time:	1.32	1:41	2:08	2:23

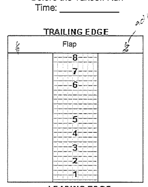
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.5	19.0	26.75
8	/	16.25	30.0
Flap	/	12.5	25.25
Time:	1:43	2:09	2:24

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	2
3			
4			
5	127	200	7
6			
7			
8	119	142	14
Flap	35	9	11
Time:	1:45	2:10	2:25

CYCLE TRACKING

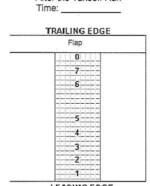
1 2 3 4 hold time
5 mins (checked 1–4, hold), 10 mins (checked 1–4, hold), 15 mins (checked 1–4, hold), 20 mins (checked 1–4, hold), 25 mins, 30 mins, 35 mins, 40 mins, 45 mins, 50 mins, 55 mins, 60 mins, 65 mins, 70 mins, 75 mins, 80 mins, 85 mins, 90 mins, 95 mins, 100 mins, 105 mins, 110 mins, 115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

Wing and Plate Condition Before the Takeoff Run
Time: ___________

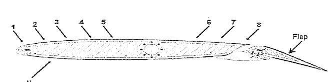


Comments: ___________

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 / CS

https://rheasystemsa.sharepoint.com/sites/APS/Library/Projects/300293 (TC Deicing 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C128: Run # 128

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: January 28, 2022

Run: 129 (E10)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.5	-7.4	-10.0	-9.5
T5	-5.7	-7.2	-7.3	-9.2
TU	-6.4	-6.6	-7.7	-9.0
Time:	2:39	2:48	3:15	3:24

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.0	22.75	dry
8	/	21.75	31.75
Flap	/	18.0	30.0
Time:	2:49	3:15	3:26

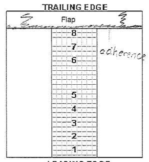
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	119	80	<1
3			
4			
5	200	250	4
6			
7			
8	158	158	10
Flap	40	gslush	1
Time:	2:50	3:15	3:28

CYCLE TRACKING

time	1	2	3	4	hold
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

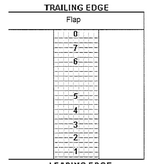


LEADING EDGE

Comments: ___________

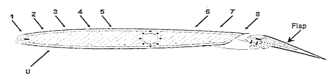
Wing and Plate Condition
After the Takeoff Run
Time: ___________

TRAILING EDGE



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 2021-22)/Procedures/Wind Tunnel/RJ Procedure/Supporting Docs/Data Forms/Fluid Thickness, Temperature and Brix Form Version 8.0.xlsx

Figure C129: Run # 129

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APPENDIX D

2021-22 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/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
1	9-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.27%	-3.33	-4.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	9-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.41%	-3.33	-4.6	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	9-Jan-22	P112	Type IV Validation and New Fluids	IP Mod	ClearWing ECO	8	100	20	8.94%	-4.99	-5.4	-4.9	-8.7	75	-	-	-	15	2	2	2.9	1	1.75	2	1	1	1.15
4	9-Jan-22	P107	Type IV Validation and New Fluids	IP-	ClearWing ECO	8	100	20	7.23%	-5.09	-7	-6.5	-8.6	25	-	-	-	50	2	1.9	2.75	1.05	1.35	1.75	1	1	1.25
5	10-Jan-22	P060	Type IV Validation and New Fluids	IP Mod	ChemR Nordik IV	8	100	20	1.16%	-8.25	-9.1	-7.7	-12.4	75	-	-	-	35	2.1	2	4	1	1.1	1.2	1	1	1.05
6	10-Jan-22	P093	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	1.91%	-7.66	-10	-9.6	-13.2	75	-	-	-	25	2.35	2.25	4	1	1.1	1.25	1	1	1.05
7	10-Jan-22	P191	Type IV Validation and New Fluids	IP Mod	FCY-EGIV	8	100	20	1.77%	-9.23	-11	-9.8	-14.2	75	-	-	-	25	2.7	2	4	1	1.1	1.5	1	1	1.05
8	10-Jan-22	P212	Type IV Validation and New Fluids	IP- / SN-	Polar Guard® Xtend	8	100	20	7.57%	-7.98	-11.3	-9.6	-11.1	25	10	-	-	15	2	1.9	3.1	1	2.25	2	1	1.15	1.65
9	10-Jan-22	P001	Baseline	Dry Wing	none	8	115	20	0.41%	-10.58	-16.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	10-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	1.23%	-10.58	-16.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11	10-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	3.14%	-15.83	-18.3	-14.7	-17.2	75	-	-	-	25	3.05	2.9	4	1	1.2	1.35	1	1	1.1
12	10-Jan-22	P219	Type IV Validation and New Fluids	IP Mod	Polar Guard® Xtend	8	115	20	8.94%	-16.25	-19.2	-16.2	-16.6	75	-	-	-	10	2.25	2	3.65	1	1.9	2.3	1	1.1	1.35

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
13	11-Jan-22	P217	Type IV Validation and New Fluids	IP-	Polar Guard® Xtend	8	115	20	9.35%	-16.61	-20.8	-17.5	-15.9	25	-	-	-	30	2.05	2	3.55	1.05	2	2.4	1	1.1	1.65
14	11-Jan-22	P079	Type IV Validation and New Fluids	Fluid Only	ChemR Nordik IV	8	100	20	4.77%	-18.99	-21.4	-18.2	-16.1	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15	11-Jan-22	P105	Type IV Validation and New Fluids	Fluid Only	Defrost NORTH 4	8	100	20	5.32%	-19.09	-22	-18.7	-15.7	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	11-Jan-22	P129	Type IV Validation and New Fluids	Fluid Only	ClearWing ECO	8	100	20	10.85%	-19.64	-22.7	-17.6	-15.8	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17	11-Jan-22	P201	Type IV Validation and New Fluids	Fluid Only	FCY-EGIV	8	100	20	3.55%	-19.81	-22.8	-19.3	-16.9	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18	11-Jan-22	P225	Type IV Validation and New Fluids	Fluid Only	Polar Guard® Xtend	8	100	20	6.41%	-19.91	-23.2	-19.7	-17.2	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
19	11-Jan-22	P217	Type IV Validation and New Fluids	IP-	Polar Guard® Xtend	8	115	20	8.25%	-20.06	-23.9	-19.1	-19.4	25	-	-	-	20	2.25	2.05	3.3	1.05	2	2.2	1	1.1	1.3
20	11-Jan-22	P124	Type IV Validation and New Fluids	IP-	ClearWing ECO	8	115	20	11.87%	-20.07	-24.3	-19.9	-19.8	25	-	-	-	20	2	2	2.85	1.1	2	2.45	1	1.2	1.6
21	11-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	0.34%	-14.05	-19.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
22	11-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.48%	-14.05	-19.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
23	11-Jan-22	P626	EG Type IV Expansion	IP Mod	Defrost NORTH 4	8	100	20	4.91%	-16.31	-18.6	-14.7	-17.6	75	-	-	-	25	3.25	2.9	4	1	1.15	1.35	1	1.1	1.15
24	11-Jan-22	P655	EG Type IV Expansion	IP Mod	FCY-EGIV	8	100	20	4.71%	-15.4	-18.6	-14.5	-17.9	75	-	-	-	25	3.25	3	4	1	1.15	1.85	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/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
25	12-Jan-22	P123	Type IV Validation and New Fluids	IP Mod	ClearWing ECO	8	115	20	n/a	n/a	n/a	-14.9	-16.7	75	-	-	-	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
26	12-Jan-22	P123	Type IV Validation and New Fluids	IP Mod	ClearWing ECO	8	115	20	9.41%	-13.42	-17.3	-12.2	-15.0	75	-	-	-	10	2	1.85	3	1.15	2	2.15	1	1.35	1.75
27	12-Jan-22	P128	Type IV Validation and New Fluids	Fluid Only	ClearWing ECO	8	100	20	10.50%	-14.02	-17.17	-12.8	-13.1	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
28	12-Jan-22	P217	Type IV Validation and New Fluids	IP-	Polar Guard® Xtend	8	115	20	6.48%	-13.99	-16.9	-11.5	-14.0	25	-	-	-	30	2.1	2	3	1	1.35	1.85	1	1.05	1.25
29	12-Jan-22	P224	Type IV Validation and New Fluids	Fluid Only	Polar Guard® Xtend	8	100	20	6.28%	-11.47	-16.7	-10.7	-11.7	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
30	12-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.27%	-2.87	-8.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
31	12-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.75%	-2.87	-8.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
32	12-Jan-22	P203	Type IV Validation and New Fluids	IP-	Polar Guard® Xtend	8	100	20	3.75%	-3.05	-7.6	-4.4	-8.1	25	-	-	-	50	2	1.8	3	1	1.2	1.4	1	1	1.05
33	13-Jan-22	P055	Type IV Validation and New Fluids	IP-	ChemR Nordik IV	8	100	20	1.23%	-4.21	-7.8	-4.4	-9.3	25	-	-	-	70	2.25	1.9	4	1	1.1	1.25	1	1	1.05
34	13-Jan-22	P608	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	0.89%	-3.12	-7.7	-5.0	-8.8	25	-	-	-	90	2.6	2.15	4	1	1	1	1	1	1
35	13-Jan-22	P637	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	1.50%	-3.84	-7.5	-4.2	-8.1	25	-	-	-	90	2.7	2.2	4	1	1	1.05	1	1	1
36	13-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.34%	-1.75	-6.8	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	13-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	-0.07%	-1.75	-6.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
38	13-Jan-22	P208	Type IV Validation and New Fluids	IP Mod	Polar Guard® Xtend	8	100	20	4.23%	-2.6	-6.7	-3.4	-9.1	75	-	-	-	15	2.05	2	3	1	1.35	1.35	1	1	1.05
39	13-Jan-22	P642	EG Type IV Expansion	IP Mod	FCY-EGIV	8	100	20	1.16%	-3.42	-6.2	-4.3	-10.7	75	-	-	-	45	3.5	3.1	4	1	1	1.05	1	1	1
40	14-Jan-22	P086	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	1.23%	-4.44	-6.1	-3.6	-11.4	75	-	-	-	35	3	2.4	4	1	1	1.15	1	1	1
41	14-Jan-22	P082	Type IV Validation and New Fluids	IP- / SN-	Defrost NORTH 4	8	100	20	0.95%	-3.15	-5.62	-4.9	-9.8	25	10	-	-	50	3	2.35	4	1	1.15	1.05	1	1	1
42	14-Jan-22	P126	Type IV Validation and New Fluids	Fluid Only	ClearWing ECO	8	100	20	8.32%	-4.12	-5.8	-4.9	-6.4	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
43	14-Jan-22	P108	Type IV Validation and New Fluids	IP- / SN-	ClearWing ECO	8	100	20	9.00%	-4.65	-6.7	-3.6	-8.4	25	10	-	-	40	2.4	2	3.75	1.1	2	2.75	1	1.15	2
44	14-Jan-22	P222	Type IV Validation and New Fluids	Fluid Only	Polar Guard® Xtend	8	100	20	5.66%	-5.13	-7.6	-5.8	-6.0	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
45	16-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.75%	-12.06	-16.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
46	16-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.82%	-12.06	-16.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
47	16-Jan-22	P595	EG Type IV Expansion	IP-	ChemR Nordik IV	8	100	20	1.64%	-14.51	-16.7	-13.9	-15.3	25	-	-	-	50	2.25	1.95	3.2	1	1.2	1.2	1	1	1
48	17-Jan-22	P624	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	2.93%	-13.61	-15.6	-13.4	-15.0	25	-	-	-	70	2.75	2.35	3.8	1	1.1	1.35	1	1	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/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
49	17-Jan-22	P653	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	2.52%	-13.08	-14.4	-11.5	-14.2	25	-	-	-	60	2.55	2.25	3.55	1	1.1	1.2	1	1	1
50	17-Jan-22	P121	Type IV Validation and New Fluids	IP-	ClearWing ECO	8	115	20	9.28%	-12.04	-13.1	-11.4	-12.7	25	-	-	-	30	2	1.9	2.75	1.25	2	2.1	1.2	1.3	1.6
51	17-Jan-22	P218	Type IV Validation and New Fluids	IP- / SN-	Polar Guard® Xtend	8	115	20	7.91%	-9.3	-11.9	-10.6	-10.4	25	10	-	-	15	2.4	2.1	3	1.1	1.85	2.1	1	1.1	1.25
52	17-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.34%	-4.52	-6.3	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
53	17-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	-0.07%	-4.52	-6.3	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
54	17-Jan-22	P058	Type IV Validation and New Fluids	IP- / ZR-	ChemR Nordik IV	8	100	20	4.02%	-5.6	-7.4	-5.5	-7.2	25	-	25	-	40	3	2.8	5	1	1.05	5	1	1	5
55	18-Jan-22	P084	Type IV Validation and New Fluids	IP- / ZR-	Defrost NORTH 4	8	100	20	4.50%	-7.02	-8.5	-7.1	-8.3	25	-	25	-	40	2.85	2.55	5	1	1	5	1	1	5
56	18-Jan-22	P110	Type IV Validation and New Fluids	IP- / ZR-	ClearWing ECO	8	100	20	8.12%	-5.29	-8.6	-8.0	-6.9	25	-	25	-	25	2.8	2.55	5	1	1.5	5	1	1.15	5
57	18-Jan-22	P182	Type IV Validation and New Fluids	IP- / ZR-	FCY-EGIV	8	100	20	4.71%	-5.85	-9.1	-7.6	-7.5	25	-	25	-	40	3	2.65	5	1	1	5	1	1	5
58	18-Jan-22	P206	Type IV Validation and New Fluids	IP- / ZR-	Polar Guard® Xtend	8	100	20	6.75%	-6.91	-9.9	-8.6	-7.4	25	-	25	-	25	3	2.85	5	1	1.35	5	1	1.1	5
59	18-Jan-22	P127	Type IV Validation and New Fluids	Fluid Only	ClearWing ECO	8	100	20	9.41%	-10.31	-10.9	-9.7	-10.4	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
60	18-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.20%	-7.71	-16	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	18-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.82%	-7.71	-16	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
62	18-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.41%	-10.16	-16.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
63	18-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.27%	-10.16	-16.2	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
64	18-Jan-22	P064	Type IV Validation and New Fluids	IP- / SN-	ChemR Nordik IV	8	100	20	2.05%	-9.6	-17.3	-12.3	-13.9	25	10	-	-	30	2.85	2.45	3.7	1	1.15	1.5	1	1.05	1.15
65	19-Jan-22	P090	Type IV Validation and New Fluids	IP- / SN-	Defrost NORTH 4	8	100	20	3.82%	-10.97	-17.5	-11.7	-14.2	25	10	-	-	30	2.9	2.5	3.85	1	1.15	1.45	1	1	1.15
66	19-Jan-22	P188	Type IV Validation and New Fluids	IP- / SN-	FCY-EGIV	8	100	20	3.14%	-11.18	-17.5	-11.9	-14.5	25	10	-	-	30	2.95	2.5	3.95	1.05	1.15	1.4	1.05	1.05	1.15
67	19-Jan-22	P122	Type IV Validation and New Fluids	IP- / SN-	ClearWing ECO	8	115	20	9.21%	-11.35	-17.2	-13.0	-13.1	25	10	-	-	15	2.6	2.3	3	1.1	1.6	1.95	6	1.15	1.5
68	19-Jan-22	P218	Type IV Validation and New Fluids	IP- / SN-	Polar Guard® Xtend	8	115	20	6.28%	-12.33	-16.7	-12.9	-12.5	25	10	-	-	15	2.55	2.25	3	1.1	1.2	1.6	1.1	1.15	1.45
69	19-Jan-22	P469	PG Type IV Expansion	IP Mod	Polar Guard® Advance	8	115	20	6.68%	-14.98	-16.2	-13.7	-15.5	75	-	-	-	15	3	2.6	4	1.05	1.5	2.5	1.05	1.1	1.15
70	19-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-1.09%	-1.4	-4.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
71	19-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.95%	-1.4	-4.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
72	19-Jan-22	P056	Type IV Validation and New Fluids	IP- / SN-	ChemR Nordik IV	8	100	20	0.61%	-4.27	-5.81	-2.6	-8.9	25	10	-	-	50	3	2.5	4	1	1.15	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/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
73	20-Jan-22	P204	Type IV Validation and New Fluids	IP- / SN-	Polar Guard® Xtend	8	100	20	5.87%	-5.11	-8.3	-5.5	-9.5	25	10	-	-	40	2.75	2.45	4	1.05	1.4	2.5	1	1.1	1.3
74	20-Jan-22	P216	Type IV Validation and New Fluids	IP Mod/ZD	Polar Guard® Xtend	8	100	20	5.93%	-9.89	-10.9	-7.9	-10.2	75	-	13	-	7	2.4	2.05	3	1	1.15	1.55	1	1.05	1.2
75	20-Jan-22	P068	Type IV Validation and New Fluids	IP Mod/ZD	ChemR Nordik IV	8	100	20	1.43%	-10.95	-12	-9.9	-12.9	75	-	13	-	10	2.6	2.3	2.65	1	1.1	1.2	1	1.05	1.05
76	20-Jan-22	P622	EG Type IV Expansion	IP Mod/ZD	Defrost NORTH 4	8	100	20	3.68%	-10.18	-13.4	-10.7	-13.5	75	-	13	-	20	3	2.9	4	1	1.1	4	1	1	4
77	20-Jan-22	P243	EG Type IV Expansion	IP-	DOW EG106	8	100	20	0.82%	-15.45	-16	-13.5	-16.0	25	-	-	-	50	2.55	2.05	3.8	1	1.1	1.25	1	1.05	1.05
78	20-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.48%	-9.27	-18.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
79	20-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.00%	-9.27	-18.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
80	20-Jan-22	P596	EG Type IV Expansion	IP- / SN-	ChemR Nordik IV	8	100	20	2.52%	-12.58	-18.5	-15.0	-16.1	25	10	-	-	30	3	2.7	3.7	1	1.2	1.45	1	1.1	1.1
81	20-Jan-22	P273	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	7.23%	-15.99	-19.6	-16.0	-17.7	25	10	-	-	30	3	2.55	4	1.15	1.85	2.6	1.05	1.35	2.2
82	21-Jan-22	P274	EG Type IV Expansion	IP Mod	ClearWing EG	8	100	20	3.82%	-16.62	-20.6	-17.6	-19.2	75	-	-	-	25	3.7	3	4	1	1.4	2.5	1	1.1	2.15
83	21-Jan-22	P272	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	3.55%	-15.91	-21.5	-17.7	-17.7	25	-	-	-	50	2.65	2.5	4	1.1	1.45	2.05	1.1	1.15	1.45
84	21-Jan-22	P301	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	3.07%	-17.45	-22.2	-18.1	-19.5	25	-	-	-	50	2.65	2.45	3.6	1	1.3	1.7	1	1	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/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
85	21-Jan-22	P600	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.93%	-17.02	-22.78	-19.0	-20.4	75	-	-	-	20	3.3	3	3.8	1	1.15	1.55	1	1.05	1.15
86	23-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.48%	-8.08	-16.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
87	23-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	-0.07%	-8.08	-16.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
88	23-Jan-22	P625	EG Type IV Expansion	IP- / SN-	Defrost NORTH 4	8	100	20	4.37%	-11.71	-17.4	-13.5	-15.6	25	10	-	-	30	3	2.65	3.8	1	1.15	1.45	1	1	1.05
89	23-Jan-22	P331	EG Type IV Expansion	IP- / SN-	Safewing EG IV NORTH	8	100	20	3.96%	-13.59	-17.6	-14.0	-16.4	25	10	-	-	30	2.75	2.5	4	1	1.15	1.5	1	1	1.15
90	24-Jan-22	P654	EG Type IV Expansion	IP- / SN-	FCY-EGIV	8	100	20	4.50%	-13.13	-18	-14.9	-17.2	25	10	-	-	30	3.05	2.6	4	1	1.2	1.75	1	1	1.25
91	24-Jan-22	P303	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	4.09%	-15.6	-19.07	-15.2	-18.8	75	-	-	-	20	3.15	3	4	1	1.1	1.25	1	1	1.05
92	24-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	DOW EG106	8	100	20	4.43%	-14.06	-19.6	-15.6	-18.2	75	25	-	-	15	3.5	2.9	4	1.1	1.35	1.55	1	1.2	1.25
93	24-Jan-22	E2	Moderate Ice Pellets and Snow	IP / SN	ClearWing EG	8	100	20	8.32%	-14.73	-21.4	-15.7	-18.4	75	25	-	-	10	3.2	2.75	3.9	1.1	1.45	2.1	1	1.35	2
94	24-Jan-22	E3	Moderate Ice Pellets and Snow	IP / SN	Max Flight SNEG	8	115	20	9.48%	-16.7	-21.9	-16.5	-18.7	75	25	-	-	7	3.4	3	4	1.2	2	4	1.1	1.4	4
95	24-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	0.00%	-8.3	-14.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
96	24-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	1.43%	-8.3	-14.8	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
97	24-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	0.14%	-12.35	-14.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
98	24-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.14%	-12.35	-14.9	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
99	24-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.48%	-11.53	-14.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
100	24-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.41%	-11.53	-14.8	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
101	24-Jan-22	P588	EG Type IV Expansion	IP-	ChemR Nordik IV	8	100	20	1.64%	-10.66	-14.7	-12.0	-12.9	25	-	-	-	70	2.75	2.4	3.6	1	1.15	1.2	1	1.05	1.05
102	25-Jan-22	P617	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	2.05%	-9.1	-14.5	-10.9	-12.8	25	-	-	-	70	2.65	2.35	3.65	1	1	1.15	1	1	1
103	25-Jan-22	P646	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	0.82%	-9.49	-14.4	-11.1	-12.2	25	-	-	-	70	2.55	2.3	3.9	1	1.05	1.2	1	1	1
104	25-Jan-22	P211	Type IV Validation and New Fluids	IP-	Polar Guard® Xtend	8	100	20	7.09%	-9.22	-14.4	-9.5	-12.0	25	-	-	-	30	2.1	2	3	1	1.65	1.75	1	1.05	1.2
105	25-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.75%	-7.25	-14.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
106	25-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.27%	-7.25	-14.4	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
107	25-Jan-22	P215	Type IV Validation and New Fluids	IP Mod	Polar Guard® Xtend	8	100	20	9.28%	-12.18	-15.2	-12.0	-13.9	75	-	-	-	10	2.25	2	3.1	1	2	2	1	1.1	1.45
108	25-Jan-22	P115	Type IV Validation and New Fluids	IP-	ClearWing ECO	8	100	20	11.39%	-9.29	-16.7	-12.6	-12.9	25	-	-	-	30	2.35	2.15	2.95	1.15	2	2.1	1.15	1.9	1.95

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	26-Jan-22	E3	Moderate Ice Pellets and Snow	IP / SN	Max Flight SNEG	8	115	20	7.98%	-13.61	-17.8	-13.3	-15.4	75	25	-	-	5	3	2.45	3.75	1.05	1.3	3.6	1	1.1	2.2
110	26-Jan-22	E4	Moderate Ice Pellets and Snow	IP / SN	Defrost NORTH 4	8	100	20	5.18%	-13.33	-18.5	-14.7	-16.9	75	25	-	-	15	3.5	3.05	4	1	1.2	1.65	1	1	1.15
111	26-Jan-22	E5	Moderate Ice Pellets and Snow	IP / SN	Safewing EG IV NORTH	8	100	20	4.23%	-14.1	-19.5	-15.2	-17.4	75	25	-	-	10	3	2.55	3.75	1	1.2	1.4	1	1	1.1
112	26-Jan-22	E6	Moderate Ice Pellets and Snow	IP / SN	Defrost ECO 4	8	115	20	8.46%	-15.34	-20.2	-15.2	-16.3	75	25	-	-	5	2.95	2.55	3.5	1.05	1.4	2	1	1.15	1.5
113	26-Jan-22	E7	Moderate Ice Pellets and Snow	IP / SN	ChemR Nordik IV	8	100	20	3.96%	-15.38	-21	-15.7	-17.7	75	25	-	-	10	3.2	2.85	3.6	1.05	1.25	1.6	1	1.15	1.25
114	26-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	0.20%	-14.59	-19.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
115	26-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.68%	-14.59	-19.7	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
116	26-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	EG106	8	100	20	3.55%	-14.36	-21.1	-15.5	-17.4	75	25	-	-	10	2.9	2.35	3.5	1	1.2	1.45	1	1.1	1.1
117	26-Jan-22	E8	Moderate Ice Pellets and Snow	IP / SN	Polar Guard Advance	8	115	20	7.64%	-15.04	-22.2	-15.6	-17.4	75	25	-	-	5	3.05	2.35	4	1.15	1.45	3.9	1.1	1.4	3.85
118	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.46%	-15.75	-22.8	-16.8	-18.9	75	-	-	-	20	3.1	3	3.7	1	1.15	1.3	1	1.1	1.2
119	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.80%	-16.08	-23.8	-17.5	-19.2	75	-	-	-	15	3.1	3	3.4	1	1.15	1.3	1	1.05	1.1
120	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	3.27%	-18.36	-23.6	-17.7	-18.9	75	-	-	-	10	3	2.75	3	1	1.2	1.5	1	1.1	1.15

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
121	27-Jan-22	P099	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	5.25%	-17.35	-22.9	-17.5	-19.1	75	-	-	-	10	3	2.5	3.4	1	1.2	1.65	1	1	1.15
122	27-Jan-22	P196 A	Type IV Validation and New Fluids	IP Mod	FCY-EGIV	8	115	20	2.46%	-16.02	-22.5	-16.8	-19.3	75	-	-	-	10	2.8	2.55	3.1	1	1.2	1.35	1	1	1
123	27-Jan-22	P196	Type IV Validation and New Fluids	IP-	FCY-EGIV	8	115	20	3.14%	-15.24	-21.8	-17.8	-18.3	25	-	-	-	30	2.6	2.2	3.45	1	1.1	1.25	1	1	1.1
124	27-Jan-22	P001	Baseline	Dry Wing	none	8	100	20	-0.14%	1.92	-4.3	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
125	27-Jan-22	P002	Baseline	Dry Wing	none	22	80	20	0.20%	-3.45	-4.1	n/a	n/a	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
126	27-Jan-22	P206	Type IV Validation and New Fluids	IP- / ZR-	Polar Guard® Xtend	8	100	20	3.07%	-2.57	-3.79	-3.0	-4.9	25	-	25	-	25	2.4	2.3	5	1	1	2.25	1	1	1
127	28-Jan-22	P084	Type IV Validation and New Fluids	IP- / ZR-	Defrost NORTH 4	8	100	20	7.57%	-3.67	-3.8	-3.2	-6.0	25	-	25	-	40	2.45	2	5	1	1	5	1	1	5
128	28-Jan-22	E9	PG Type IV Expansion	IP/ZR/ SN	Polar Guard Xtend	8	100	20	3.34%	-3.99	-5.2	-3.2	-5.2	25	10	25	-	20	2.65	2.2	5	1	1.05	5	1	1	5
129	28-Jan-22	E10	EG Type IV Expansion	IP/ZR/ SN	ChemR Nordik IV	8	100	20	3.00%	-6.65	-8.5	-6.2	-8.3	25	10	25	-	20	2.85	2.55	5	1	1	1	1	1	1

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APPENDIX E

LOG OF ALL EG FLUID TESTS

Log of All EG Fluid Tests

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	-10.1	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	-4.3	-8.5	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	-3.4	-9.0	25	10	-	-	40	2.3	2.2	4.0	1.0	1.2	1.5	1.0	1.0	1.0
24	21-Jan-10	P037	IP Expansion	IP- / SN	EG106	8	100	20	1.25%	-3.7	-6.1	-3.7	N/A	25	25	-	-	20	2.5	1.8	4.0	1.0	1.2	1.0	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	-3.1	-6.2	25	-	25	-	25	2.2	1.7	4.7	1.0	1.0	4.0	1.0	1.0	3.5
44	23-Jan-10	P040	IP Expansion	IP- / R Mod	EG106	8	100	20	28.25%	-0.8	-8	-4.8	-1.2	25	-	-	75	40	5.0	4.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0
45	23-Jan-10	P127	Roughness	IP- / R Mod	EG106	13	100	20	25.54%	-6	-8	N/A	N/A	25	-	-	75	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
56	27-Jan-10	P040 A	IP Validation	IP- / R Mod	EG106	8	100	20	2.63%	-1.1	-5.7	-1.3	-4.3	25	-	-	75	25	1.8	2.0	4.7	1.0	1.0	5.0	1.0	1.0	5.0
67	29-Jan-10	P016	IP Validation	IP-	EG106	8	100	20	1.06%	-12.6	-19.3	-14.7	-15.0	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	-16.6	-17.2	75	-	-	-	10	2.3	2.3	2.8	1.0	1.3	1.8	1.0	1.0	1.2
79	30-Jan-10	P049	IP Expansion	IP- / SN-	EG106	8	100	20	3.16%	-14.8	-22.7	-16.2	-15.7	25	10	-	-	10	2.2	2.0	2.5	1.0	1.5	2.0	1.0	1.0	1.0
80	30-Jan-10	P028	IP Validation	IP-	EG106	8	100	20	2.31%	-17	-22.9	-16.7	-18.5	25	-	-	-	30	2.5	2.2	3.0	1.0	1.3	1.7	1.0	1.0	1.0

Log of All EG Fluid Tests (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
81	30-Jan-10	P052	IP Expansion	IP- / SN	EG106	8	100	20	3.19%	-17.3	-22.9	-16.5	-17.1	25	25	-	-	5	1.8	2.0	2.3	1.0	1.5	2.0	1.0	1.0	1.0
98	2-Feb-10	P022	IP Validation	IP- / ZR-	EG106	8	100	20	1.20%	-6.7	-14.1	-9.5	-8.4	25	-	25	-	10	2.0	2.0	2.5	1.0	1.0	1.3	1.0	1.0	1.0
26A	21-Jan-10	P007	IP Validation	IP- / ZR-	EG106	8	100	0	1.29%	-3.3	-5.9	-2.8	-6.2	25	-	25	-	25	1.8	2.0	1.9	1.0	1.0	1.0	1.0	1.0	1.0
45A	23-Jan-10	P127	Roughness	IP- / R Mod	EG106	15	100	20	25.57%	-6.1	-8.3	N/A	N/A	25	-	-	75	-	-	-	-	-	-	-	-	-	-
45B	23-Jan-10	P127	Roughness	IP- / R Mod	EG106	15	100	20	20.33%	-4.1	-8.5	N/A	N/A	25	-	-	75	-	-	-	-	-	-	-	-	-	-
56A	27-Jan-10	P040 A	IP Expansion	IP- / R Mod	EG106	8	100	0	2.61%	-1.4	-6.2	-3.2	-2.4	25	-	-	75	25	1.8	2.2	3.0	1.0	1.0	4.3	1.0	1.0	4.3
78	30-Jan-11	P105	IP Expansion	IP- / SN-	EG106	8	100	20	2.67%	-13.8	-16.3	-10.7	-14.2	25	10	-	-	25	2.7	2.2	4.0	1.0	1.6	1.8	1.0	1.0	1.2
79	31-Jan-11	P108	IP Expansion	IP- / SN	EG106	8	100	20	3.02%	-15.1	-17.3	-12.6	-12.9	25	25	-	-	15	2.8	2.6	4.0	1.1	1.4	1.8	1.0	1.0	1.2
115	7-Feb-11	P117	IP Data Gap	IP- / R Mod	EG106	8	100	20	0.42%	1.4	0.7	3.4	1.5	25	-	-	75	25	2.3	1.3	1.6	1.0	1.0	1.0	1.0	1.0	1.0
118	7-Feb-11	E11	IP/R/SN	IP/R/SN	EG106	8	100	20	1.34%	1	-0.3	3.6	-0.5	25	25	-	25	25	2.0	1.3	3.5	1.0	1.0	1.2	1.0	1.0	1.0
126	8-Feb-11	E16	IP Expansion / CL Max	IP- / ZR-	EG106	18	100	20	7.24%	-10.1	-15.5	-11.6	-9.4	25	-	25	-	40	3.7	3.0	4.3	1.2	1.5	5.0	1.0	1.2	5.0
135	10-Feb-11	E19	IP/ZR/SN	IP/ZR/SN	EG106	8	100	20	5.27%	-3.9	-10	-8.9	-8.2	25	25	25	-	20	2.2	2.3	4.3	1.0	1.0	5.0	1.0	1.0	5.0

Log of All EG Fluid Tests (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
124	30-Jan-12	E17	Fluid Tests - Repeatibility	IP Mod	EG106	8	100		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		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	-16.4	-18.7	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	-21.0	-19.6	25	10	-	-	15	1.9	1.9	2.3	1.1	1.5	1.7	1.0	1.1	1.2
364	28-Jan-14	E4	Type III Allowance Times	IP Mod	EG106	8	100	20	1.56%	-7.1	-10.2	-10.2	-11.3	75	-	-	-	10	2.3	2.3	2.8	3.0	5.0	5.0	3.0	5.0	5.0
10	19-Jan-16	P082	Type IV Validation and New Fuids	IP-	LNT E450	8	100	20	5.82%	-15.2	-16.8	-14.5	-15.1	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	-14.7	-15.5	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	-14.6	-15.2	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	-7.2	-7.8	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	-7.0	-2.2	25	10	-	-	15	1.7	2.0	2.4	1.0	1.4	1.7	1.0	1.0	1.2
68	25-Jan-16	P073	Type IV Validation and New Fuids	IP- / ZR-	LNT E450	8	100	20	3.11%	-1.3	-6.7	-3.3	-6.4	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	-2.6	-9.8	75	-	-	-	25	2.3	2.5	4.0	1.0	1.4	1.9	1.0	1.0	1.0

Log of All EG Fluid Tests (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
76	26-Jan-16	P074	Type IV Validation and New Fuids	IP- / R-	LNT E450	8	100	20	4.28%	0.0	-4	-1.0	-4.1	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	-7.9	-8.5	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	-8.4	-11.3	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	-7.8	-11.6	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	-9.0	-13.1	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	-12.0	-15.1	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	-13.4	-15.2	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	-13.8	-16.6	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	-8.7	-12.3	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	-8.2	-10.0	25	-	13	-	30	2.5	2.5	4.0	1.0	1.0	5.0	1.0	1.0	1.5
33	1-Feb-18	P178	EG Type IV Expansion	IP- / SN-	ChemR EG IV	8	100	20	3.68%	-5.2	-9.7	-7.1	-10.3	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	-3.3	-7.0	75	-	-	75	10	2.2	2.2	4.7	1.0	1.0	5.0	1.0	1.0	5.0

Log of All EG Fluid Tests (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
40	1-Feb-18	P003	Type IV Validation and New Fuids	IP-	ChemR EG IV	8	100	20	1.28%	-6.8	-7.4	-4.7	-10.5	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	-8.8	-14.2	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	-10.9	-10.7	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	-21.3	-22.6	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	-22.3	-23.1	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	-21.6	-23.4	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	-22.8	-22.7	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	-5.9	-13.7	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	-5.8	-13.7	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	-1.9	-6.6	25	-	-	25	25	1.5	1.5	2.0	1.0	1.0	1.0	1.0	1.0	1.0
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	-16.2	-17.7	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	-15.3	-17.0	25	10	-	-	15	2.5	2.5	2.8	1.0	1.1	1.3	1.0	1.0	1.1

Log of All EG Fluid Tests (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
43	29-Jan-19	P118	Type IV Validation and New Fluids	IP- / ZR-	Defrost EG 4	8	100	20	4.36%	-10.07	-12	-13.5	-13.7	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	-14.3	-13.9	25	-	25	-	10	2.3	2.0	2.5	1.0	1.0	1.1	1.0	1.0	1.0
11	20-Jan-20	P127	EG Type IV Expansion	IP Mod	ChemR EG IV	8	100	20	2.11%	-13.8	-12.5	-11.9	-17.3	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	-14.2	-16.5	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	-14.6	-18.3	75	-	-	-	25	3.1	2.7	4.0	1.0	1.1	1.5	1.0	1.0	1.1
14	21-Jan-20	P153	EG Type IV Expansion	IP- / SN-	EG106	8	100	20	1.95%	-14.39	-14.4	-14.8	-17.1	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	-14.9	-18.5	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	-15.4	-17.6	25	10	-	-	30	2.5	2.3	3.8	1.0	1.1	1.4	1.0	1.0	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	2.0	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	-0.5	-1.9	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	-0.5	-3.5	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	1.2	-4.2	92	-	-	75	15	2.7	2.0	4.0	1.0	1.0	3.8	1.0	1.0	3.2

Log of All EG Fluid Tests (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	-0.3	-5.1	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	-0.3	-4.3	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	-0.2	-4.3	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	0.2	-4.5	92	-	-	75	12	1.8	2.0	4.3	1.0	1.0	1.1	1.0	1.0	1.0
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	1.8	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	1.8	-2.4	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	1.4	-3.6	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	2.5	-3.6	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	0.9	-4.3	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	1.2	-1.8	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	1.3	-4.5	75	-	-	75	20	2.0	1.7	5.0	1.0	1.0	2.3	1.0	1.0	1.1
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	2.0	1.7	5.0	1.0	1.0	1.2	1.0	1.0	1.0

Log of All EG Fluid Tests (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
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	4.3	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	-3.6	-10.1	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	-5.4	-9.8	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	-5.9	-7.5	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	-5.7	-7.9	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	-6.1	-11.5	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	-7.9	-12.2	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	-8.6	-11.6	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	-7.7	-13.6	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	-8.9	-13.9	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	-5.6	-12.3	75	-	-	-	35	2.9	2.5	4.0	1.0	1.1	1.2	1.0	1.0	1.0
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	3.0	2.5	4.0	1.0	1.0	1.1	1.0	1.0	1.0

Log of All EG Fluid Tests (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
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	3.0	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	-6.7	-10.4	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	-7.2	-8.3	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	-10.2	-13.4	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	-10.1	-13.3	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	-10.1	-13.3	25	10	-	-	30	2.6	2.3	3.9	1.0	1.2	1.8	1.0	1.1	1.1
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	2.8	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	-9.5	-9.7	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	-5.3	-9.9	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	-3.8	-9.4	25	10	-	-	50	3.0	2.5	4.0	1.0	1.2	1.5	1.0	1.0	1.0
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	3.0	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	-2.2	-4.7	25	-	25	-	40	3.0	2.6	5.0	1.0	1.0	5.0	1.0	1.0	5.0

Log of All EG Fluid Tests (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
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	2.8	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	-2.5	-5.2	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	-10.4	-11.3	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	-10.7	-11.2	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	-9.5	-12.9	75	-	13	-	10	2.6	2.5	3.5	1.0	1.1	1.3	1.0	1.1	1.1
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	2.8	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	-5.7	-10.8	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	-5.5	-10.3	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	-4.6	-10.1	75	-	13	-	20	3.0	2.6	5.0	1.0	1.1	4.5	1.0	1.0	2.0
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	1.0	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	-4.9	-7.5	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	-2.7	-9.9	75	-	-	-	35	2.8	2.6	4.0	1.0	1.0	1.1	1.0	1.0	1.0

Log of All EG Fluid Tests (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
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	3.3	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	-3.6	-9.4	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	-3.7	-8.6	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	-3.6	-7.9	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	-3.9	-9.5	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	-3.8	-8.9	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	-5.2	-9.4	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	-6.2	-10.9	75	-	13	-	20	2.7	2.5	4.5	1.0	1.0	2.0	1.0	1.0	1.0
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	2.8	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	-7.1	-7.5	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	-7.4	-7.5	25	-	25	-	40	3.0	3.0	5.0	1.4	1.8	5.0	1.1	1.3	5.0
5	10-Jan-22	P060	Type IV Validation and New Fluids	IP Mod	ChemR Nordik IV	8	100	20	1.16%	-8.25	-9.1	-7.7	-12.4	75	-	-	-	35	2.1	2.0	4.0	1.0	1.1	1.2	1.0	1.0	1.1

Log of All EG Fluid Tests (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
6	10-Jan-22	P093	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	1.91%	-7.66	-10	-9.6	-13.2	75	-	-	-	25	2.4	2.3	4.0	1.0	1.1	1.3	1.0	1.0	1.1
7	10-Jan-22	P191	Type IV Validation and New Fluids	IP Mod	FCY-EGIV	8	100	20	1.77%	-9.23	-11	-9.8	-14.2	75	-	-	-	25	2.7	2.0	4.0	1.0	1.1	1.5	1.0	1.0	1.1
11	10-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	3.14%	-15.83	-18.3	-14.7	-17.2	75	-	-	-	25	3.1	2.9	4.0	1.0	1.2	1.4	1.0	1.0	1.1
23	11-Jan-22	P626	EG Type IV Expansion	IP Mod	Defrost NORTH 4	8	100	20	4.91%	-16.31	-18.6	-14.7	-17.6	75	-	-	-	25	3.3	2.9	4.0	1.0	1.2	1.4	1.0	1.1	1.2
24	11-Jan-22	P655	EG Type IV Expansion	IP Mod	FCY-EGIV	8	100	20	4.71%	-15.4	-18.6	-14.5	-17.9	75	-	-	-	25	3.3	3.0	4.0	1.0	1.2	1.9	1.0	1.0	1.0
33	13-Jan-22	P055	Type IV Validation and New Fluids	IP-	ChemR Nordik IV	8	100	20	1.23%	-4.21	-7.8	-4.4	-9.3	25	-	-	-	70	2.3	1.9	4.0	1.0	1.1	1.3	1.0	1.0	1.1
34	13-Jan-22	P608	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	0.89%	-3.12	-7.7	-5.0	-8.8	25	-	-	-	90	2.6	2.2	4.0	1.0	1.0	1.0	1.0	1.0	1.0
35	13-Jan-22	P637	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	1.50%	-3.84	-7.5	-4.2	-8.1	25	-	-	-	90	2.7	2.2	4.0	1.0	1.0	1.1	1.0	1.0	1.0
39	13-Jan-22	P642	EG Type IV Expansion	IP Mod	FCY-EGIV	8	100	20	1.16%	-3.42	-6.2	-4.3	-10.7	75	-	-	-	45	3.5	3.1	4.0	1.0	1.0	1.1	1.0	1.0	1.0
40	14-Jan-22	P086	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	1.23%	-4.44	-6.1	-3.6	-11.4	75	-	-	-	35	3.0	2.4	4.0	1.0	1.0	1.2	1.0	1.0	1.0
41	14-Jan-22	P082	Type IV Validation and New Fluids	IP- / SN-	Defrost NORTH 4	8	100	20	0.95%	-3.15	-5.62	-4.9	-9.8	25	10	-	-	50	3.0	2.4	4.0	1.0	1.2	1.1	1.0	1.0	1.0
6	10-Jan-22	P093	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	1.91%	-7.66	-10	-9.6	-13.2	75	-	-	-	25	2.4	2.3	4.0	1.0	1.1	1.3	1.0	1.0	1.1

Log of All EG Fluid Tests (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° CI vs Dry CI	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
47	16-Jan-22	P595	EG Type IV Expansion	IP-	ChemR Nordik IV	8	100	20	1.64%	-14.51	-16.7	-13.9	-15.3	25	-	-	-	50	2.3	2.0	3.2	1.0	1.2	1.2	1.0	1.0	1.0
48	17-Jan-22	P624	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	2.93%	-13.61	-15.6	-13.4	-15.0	25	-	-	-	70	2.8	2.4	3.8	1.0	1.1	1.4	1.0	1.0	1.1
49	17-Jan-22	P653	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	2.52%	-13.08	-14.4	-11.5	-14.2	25	-	-	-	60	2.6	2.3	3.6	1.0	1.1	1.2	1.0	1.0	1.0
54	17-Jan-22	P058	Type IV Validation and New Fluids	IP- / ZR-	ChemR Nordik IV	8	100	20	4.02%	-5.6	-7.4	-5.5	-7.2	25	-	25	-	40	3.0	2.8	5.0	1.0	1.1	5.0	1.0	1.0	5.0
55	18-Jan-22	P084	Type IV Validation and New Fluids	IP- / ZR-	Defrost NORTH 4	8	100	20	4.50%	-7.02	-8.5	-7.1	-8.3	25	-	25	-	40	2.9	2.6	5.0	1.0	1.0	5.0	1.0	1.0	5.0
57	18-Jan-22	P182	Type IV Validation and New Fluids	IP- / ZR-	FCY-EGIV	8	100	20	4.71%	-5.85	-9.1	-7.6	-7.5	25	-	25	-	40	3.0	2.7	5.0	1.0	1.0	5.0	1.0	1.0	5.0
64	18-Jan-22	P064	Type IV Validation and New Fluids	IP- / SN-	ChemR Nordik IV	8	100	20	2.05%	-9.6	-17.3	-12.3	-13.9	25	10	-	-	30	2.9	2.5	3.7	1.0	1.2	1.5	1.0	1.1	1.2
65	19-Jan-22	P090	Type IV Validation and New Fluids	IP- / SN-	Defrost NORTH 4	8	100	20	3.82%	-10.97	-17.5	-11.7	-14.2	25	10	-	-	30	2.9	2.5	3.9	1.0	1.2	1.5	1.0	1.0	1.2
66	19-Jan-22	P188	Type IV Validation and New Fluids	IP- / SN-	FCY-EGIV	8	100	20	3.14%	-11.18	-17.5	-11.9	-14.5	25	10	-	-	30	3.0	2.5	4.0	1.1	1.2	1.4	1.1	1.1	1.2
72	19-Jan-22	P056	Type IV Validation and New Fluids	IP- / SN-	ChemR Nordik IV	8	100	20	0.61%	-4.27	-5.81	-2.6	-8.9	25	10	-	-	50	3.0	2.5	4.0	1.0	1.2	1.2	1.0	1.0	1.0
75	20-Jan-22	P068	Type IV Validation and New Fluids	IP Mod/ZD	ChemR Nordik IV	8	100	20	1.43%	-10.95	-12	-9.9	-12.9	75	-	13	-	10	2.6	2.3	2.7	1.0	1.1	1.2	1.0	1.1	1.1
76	20-Jan-22	P622	EG Type IV Expansion	IP Mod/ZD	Defrost NORTH 4	8	100	20	3.68%	-10.18	-13.4	-10.7	-13.5	75	-	13	-	20	3.0	2.9	4.0	1.0	1.1	4.0	1.0	1.0	4.0

Log of All EG Fluid Tests (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
77	20-Jan-22	P243	EG Type IV Expansion	IP-	DOW EG106	8	100	20	0.82%	-15.45	-16	-13.5	-16.0	25	-	-	-	50	2.6	2.1	3.8	1.0	1.1	1.3	1.0	1.1	1.1
80	20-Jan-22	P596	EG Type IV Expansion	IP- / SN-	ChemR Nordik IV	8	100	20	2.52%	-12.58	-18.5	-15.0	-16.1	25	10	-	-	30	3.0	2.7	3.7	1.0	1.2	1.5	1.0	1.1	1.1
81	20-Jan-22	P273	EG Type IV Expansion	IP- / SN-	ClearWing EG	8	100	20	7.23%	-15.99	-19.6	-16.0	-17.7	25	10	-	-	30	3.0	2.6	4.0	1.2	1.9	2.6	1.1	1.4	2.2
82	21-Jan-22	P274	EG Type IV Expansion	IP Mod	ClearWing EG	8	100	20	3.82%	-16.62	-20.6	-17.6	-19.2	75	-	-	-	25	3.7	3.0	4.0	1.0	1.4	2.5	1.0	1.1	2.2
83	21-Jan-22	P272	EG Type IV Expansion	IP-	ClearWing EG	8	100	20	3.55%	-15.91	-21.5	-17.7	-17.7	25	-	-	-	50	2.7	2.5	4.0	1.1	1.5	2.1	1.1	1.2	1.5
84	21-Jan-22	P301	EG Type IV Expansion	IP-	Max Flight AVIA	8	100	20	3.07%	-17.45	-22.2	-18.1	-19.5	25	-	-	-	50	2.7	2.5	3.6	1.0	1.3	1.7	1.0	1.0	1.1
85	21-Jan-22	P600	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.93%	-17.02	-22.7	-19.0	-20.4	75	-	-	-	20	3.3	3.0	3.8	1.0	1.2	1.6	1.0	1.1	1.2
88	23-Jan-22	P625	EG Type IV Expansion	IP- / SN-	Defrost NORTH 4	8	100	20	4.37%	-11.71	-17.4	-13.5	-15.6	25	10	-	-	30	3.0	2.7	3.8	1.0	1.2	1.5	1.0	1.0	1.1
90	24-Jan-22	P654	EG Type IV Expansion	IP- / SN-	FCY-EGIV	8	100	20	4.50%	-13.13	-18	-14.9	-17.2	25	10	-	-	30	3.1	2.6	4.0	1.0	1.2	1.8	1.0	1.0	1.3
91	24-Jan-22	P303	EG Type IV Expansion	IP Mod	Max Flight AVIA	8	100	20	4.09%	-15.6	-19.0	-15.2	-18.8	75	-	-	-	20	3.2	3.0	4.0	1.0	1.1	1.3	1.0	1.0	1.1
92	24-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	DOW EG106	8	100	20	4.43%	-14.06	-19.6	-15.6	-18.2	75	25	-	-	15	3.5	2.9	4.0	1.1	1.4	1.6	1.0	1.2	1.3
93	24-Jan-22	E2	Moderate Ice Pellets and Snow	IP / SN	ClearWing EG	8	100	20	8.32%	-14.73	-21.4	-15.7	-18.4	75	25	-	-	10	3.2	2.8	3.9	1.1	1.5	2.1	1.0	1.4	2.0

Log of All EG Fluid Tests (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
101	24-Jan-22	P588	EG Type IV Expansion	IP-	ChemR Nordik IV	8	100	20	1.64%	-10.66	-14.7	-12.0	-12.9	25	-	-	-	70	2.8	2.4	3.6	1.0	1.2	1.2	1.0	1.1	1.1
102	25-Jan-22	P617	EG Type IV Expansion	IP-	Defrost NORTH 4	8	100	20	2.05%	-9.1	-14.5	-10.9	-12.8	25	-	-	-	70	2.7	2.4	3.7	1.0	1.0	1.2	1.0	1.0	1.0
103	25-Jan-22	P646	EG Type IV Expansion	IP-	FCY-EGIV	8	100	20	0.82%	-9.49	-14.4	-11.1	-12.2	25	-	-	-	70	2.6	2.3	3.9	1.0	1.1	1.2	1.0	1.0	1.0
110	26-Jan-22	E4	Moderate Ice Pellets and Snow	IP / SN	Defrost NORTH 4	8	100	20	5.18%	-13.33	-18.5	-14.7	-16.9	75	25	-	-	15	3.5	3.1	4.0	1.0	1.2	1.7	1.0	1.0	1.2
113	26-Jan-22	E7	Moderate Ice Pellets and Snow	IP / SN	ChemR Nordik IV	8	100	20	3.96%	-15.38	-21	-15.7	-17.7	75	25	-	-	10	3.2	2.9	3.6	1.1	1.3	1.6	1.0	1.2	1.3
116	26-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	EG106	8	100	20	3.55%	-14.36	-21.1	-15.5	-17.4	75	25	-	-	10	2.9	2.4	3.5	1.0	1.2	1.5	1.0	1.1	1.1
118	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.46%	-15.75	-22.8	-16.8	-18.9	75	-	-	-	20	3.1	3.0	3.7	1.0	1.2	1.3	1.0	1.1	1.2
119	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	2.80%	-16.08	-23.8	-17.5	-19.2	75	-	-	-	15	3.1	3.0	3.4	1.0	1.2	1.3	1.0	1.1	1.1
120	27-Jan-22	P597	EG Type IV Expansion	IP Mod	ChemR Nordik IV	8	100	20	3.27%	-18.36	-23.6	-17.7	-18.9	75	-	-	-	10	3.0	2.8	3.0	1.0	1.2	1.5	1.0	1.1	1.2
121	27-Jan-22	P099	Type IV Validation and New Fluids	IP Mod	Defrost NORTH 4	8	100	20	5.25%	-17.35	-22.9	-17.5	-19.1	75	-	-	-	10	3.0	2.5	3.4	1.0	1.2	1.7	1.0	1.0	1.2
122	27-Jan-22	P196 A	Type IV Validation and New Fluids	IP Mod	FCY-EGIV	8	115	20	2.46%	-16.02	-22.5	-16.8	-19.3	75	-	-	-	10	2.8	2.6	3.1	1.0	1.2	1.4	1.0	1.0	1.0
123	27-Jan-22	P196	Type IV Validation and New Fluids	IP-	FCY-EGIV	8	115	20	3.14%	-15.24	-21.8	-17.8	-18.3	25	-	-	-	30	2.6	2.2	3.5	1.0	1.1	1.3	1.0	1.0	1.1

Log of All EG Fluid Tests (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
127	28-Jan-22	P084	Type IV Validation and New Fluids	IP- / ZR-	Defrost NORTH 4	8	100	20	7.57%	-3.67	-3.8	-3.2	-6.0	25	-	25	-	40	2.5	2.0	5.0	1.0	1.0	5.0	1.0	1.0	5.0
129	28-Jan-22	E10	EG Type IV Expansion	IP/ZR/ SN	ChemR Nordik IV	8	100	20	3.00%	-6.65	-8.5	-6.2	-8.3	25	10	25	-	20	2.9	2.6	5.0	1.0	1.0	1.0	1.0	1.0	1.0

APPENDIX F

LOG OF MIXED CONDITION TESTS: IP/SN AND IP/ZR/SN

Log of Mixed Condition Tests: IP/SN and IP/ZR/SN

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
23	20-Jan-16	P189	IP Expansion - METAR	IP / SN	ABC-S Plus	8	100	20	7.38%	-8.2	-10.2	-7.7	-9.8	75	25	-	-	7	2.3	2.7	3.5	1.1	1.7	2.4	1.0	1.0	1.2
24	20-Jan-16	P189	IP Expansion - METAR	IP / SN	ABC-S Plus	8	100	20	8.16%	-7.7	-10.4	-8.7	-10.9	75	25	-	-	10	3.0	3.0	4.0	1.2	1.8	2.5	1.0	1.1	1.2
36	21-Jan-16	P206	IP Expansion - METAR	IP / SN	Polar Guard Advance	8	100	20	11.06%	-7.4	-12	-8.6	-11.6	75	25	-	-	10	3.0	3.0	4.0	1.2	1.7	2.6	1.0	1.0	1.4
37	21-Jan-16	P206	IP Expansion - METAR	IP / SN	Polar Guard Advance	8	100	20	9.42%	-7.7	-12.6	-9.3	-11.2	75	25	-	-	7	2.8	2.5	3.7	1.1	1.4	2.5	1.0	1.1	1.4
40	21-Jan-16	P189	IP Expansion - METAR	IP / SN	ABC-S Plus	8	100	20	6.70%	-3.5	-6.9	-5.5	-8.7	75	25	-	-	7	2.9	2.7	3.4	1.1	1.9	2.1	1.0	1.0	1.1
41	21-Jan-16	P188	IP Expansion - METAR	IP / SN	ABC-S Plus	8	100	20	7.48%	-3.8	-7	-5.4	-9.3	75	25	-	-	10	2.8	2.8	3.7	1.2	2.0	2.3	1.0	1.0	1.1
45	22-Jan-16	P171	IP Expansion - METAR	IP / SN	AD-49	8	100	20	7.34%	-4.4	-7.7	-5.3	-9.2	75	25	-	-	10	2.9	2.8	4.0	1.1	1.7	2.1	1.0	1.1	1.2
52	23-Jan-16	P205	IP Expansion - METAR	IP / SN	Polar Guard Advance	8	100	20	9.27%	-4.9	-10.1	-7.1	-10.4	75	25	-	-	10	2.7	2.8	4.0	1.1	1.4	2.5	1.0	1.0	1.2
92	24-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	DOW EG106	8	100	20	4.43%	-14.06	-19.6	-15.6	-18.2	75	25	-	-	15	3.5	2.9	4	1.1	1.35	1.55	1	1.2	1.25
93	24-Jan-22	E2	Moderate Ice Pellets and Snow	IP / SN	ClearWing EG	8	100	20	8.32%	-14.73	-21.4	-15.7	-18.4	75	25	-	-	10	3.2	2.75	3.9	1.1	1.45	2.1	1	1.35	2
94	24-Jan-22	E3	Moderate Ice Pellets and Snow	IP / SN	Max Flight SNEG	8	115	20	9.48%	-16.7	-21.9	-16.5	-18.7	75	25	-	-	7	3.4	3	4	1.2	2	4	1.1	1.4	4
109	26-Jan-22	E3	Moderate Ice Pellets and Snow	IP / SN	Max Flight SNEG	8	115	20	7.98%	-13.61	-17.8	-13.3	-15.4	75	25	-	-	5	3	2.45	3.75	1.05	1.3	3.6	1	1.1	2.2

Log of Mixed Condition Tests: IP/SN and IP/ZR/SN (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
110	26-Jan-22	E4	Moderate Ice Pellets and Snow	IP / SN	Defrost NORTH 4	8	100	20	5.18%	-13.33	-18.5	-14.7	-16.9	75	25	-	-	15	3.5	3.05	4	1	1.2	1.65	1	1	1.15
111	26-Jan-22	E5	Moderate Ice Pellets and Snow	IP / SN	Safewing EG IV NORTH	8	100	20	4.23%	-14.1	-19.5	-15.2	-17.4	75	25	-	-	10	3	2.55	3.75	1	1.2	1.4	1	1	1.1
112	26-Jan-22	E6	Moderate Ice Pellets and Snow	IP / SN	Defrost ECO 4	8	115	20	8.46%	-15.34	-20.2	-15.2	-16.3	75	25	-	-	5	2.95	2.55	3.5	1.05	1.4	2	1	1.15	1.5
113	26-Jan-22	E7	Moderate Ice Pellets and Snow	IP / SN	ChemR Nordik IV	8	100	20	3.96%	-15.38	-21	-15.7	-17.7	75	25	-	-	10	3.2	2.85	3.6	1.05	1.25	1.6	1	1.15	1.25
116	26-Jan-22	E1	Moderate Ice Pellets and Snow	IP / SN	EG106	8	100	20	3.55%	-14.36	-21.1	-15.5	-17.4	75	25	-	-	10	2.9	2.35	3.5	1	1.2	1.45	1	1.1	1.1
117	26-Jan-22	E8	Moderate Ice Pellets and Snow	IP / SN	Polar Guard Advance	8	115	20	7.64%	-15.04	-22.2	-15.6	-17.4	75	25	-	-	5	3.05	2.35	4	1.15	1.45	3.9	1.1	1.4	3.85
128	28-Jan-22	E9	PG Type IV Expansion	IP/ZR/SN	Polar Guard Xtend	8	100	20	3.34%	-3.99	-5.2	-3.2	-5.2	25	10	25	-	20	2.65	2.2	5	1	1.05	5	1	1	5
129	28-Jan-22	E10	EG Type IV Expansion	IP/ZR/SN	ChemR Nordik IV	8	100	20	3.00%	-6.65	-8.5	-6.2	-8.3	25	10	25	-	20	2.85	2.55	5	1	1	1	1	1	1