TP15233E

Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2012-13

Prepared for

Transportation Development Centre

In cooperation with

Civil Aviation
Transport Canada

and

The Federal Aviation Administration
William J. Hughes Technical Center

Prepared by:

APS Aviation Inc.

December 2013

Final Version 1.0

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Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2012-13

by

Marco Ruggi

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APS Aviation Inc.

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

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

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PREFACE

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

- To develop holdover time data for all newly-qualified de/anti-icing fluids and update and maintain the website for the holdover time guidelines;
- To evaluate weather data from previous winters that can have an impact on the format of the holdover time guidelines;
- To conduct general and exploratory de/anti-icing research;
- To conduct tests to evaluate the effect of deployed flaps and slats prior to anti-icing;
- To conduct tests and research on surfaces treated with ice phobic products;
- To conduct tests to evaluate holdover times in heavy snow conditions;
- To develop an SAE International Aerospace Information Report for the evaluation of aircraft coatings;
- To support the evaluation of the National Research Council Canada Propulsion Icing Wind Tunnel to determine its flow characteristics;
- To develop holdover time guidance for operation in ice crystal conditions;
- To continue research for development of ice detection capabilities for pre-deicing, engine deicing and departing aircraft at the runway threshold;
- To develop a performance specification for electronic holdover time applications;
- To investigate pre-takeoff contamination check 5-minute allowance;
- To conduct full-scale general aviation aircraft windshield washer fluid deicing testing to substantiate and support flat plate testing results;
- To update the regression coefficient report with the newly-qualified de/anti-icing fluids; and
- To develop Type II/IV holdover times in light and very light snow conditions.

The research activities of the program conducted on behalf of Transport Canada during the winter of 2012-13 are documented in seven reports. The titles of the reports are as follows:

- TP 15227E Winter Weather Impact on Holdover Time Table Format (1995-2013);
- TP 15228E Aircraft Ground De/Anti-Icing Fluid Holdover Time Development Program for the 2012-13 Winter;
- TP 15229E Regression Coefficients and Equations Used to Develop the Winter 2013-14 Aircraft Ground Deicing Holdover Time Tables;
- TP 15230E Aircraft Ground Icing General Research Activities During the 2012-13 Winter;

- TP 15231E Cold Climate Technologies – Investigation of Sensor Technologies as an Alternative Means of Detecting Aircraft Icing (Year 2 of 3);
- 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; and
- TP 15233E Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2012-13.

In addition, the following two interim reports are being prepared:

- *Investigation of Ice Phobic Technologies to Reduce Aircraft Icing in Northern and Cold Climates (Year 2 of 3); and*
- *Evaluation of Endurance Times on Extended Flaps and Slats.*

This report, TP 15233E, has the following objective:

- To conduct various aerodynamic research activities at the National Research Council Canada wind tunnel.

This objective was met by conducting a series of full-scale tests using a supercritical wing section mounted in the National Research Council Canada open circuit wind tunnel to examine the flow-off properties of anti-icing fluids contaminated with various forms of simulated freezing precipitation to investigate several recent industry operational concerns; this work was completed in conjunction with the ice pellet research being conducted at the National Research Council Canada Propulsion Icing Wind Tunnel.

PROGRAM ACKNOWLEDGEMENTS

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

APS Aviation Inc. would also like to acknowledge the dedication of the research team, whose performance was crucial to the acquisition of hard data. This includes the following people: Yelyzaveta Asnytska, Brandon Auclair, Steven Baker, Stephanie Bendickson, Kirby Bennett, Patrick Caines, John D'Avirro, Jesse Dybka, Derek Foebel, Benjamin Guthrie, Dany Posteraro, Marco Ruggi, James Smyth, Fillipo Suriano, David Youssef, and Victoria Zoitakis.

Special thanks are extended to Howard Posluns, Yvan Chabot, Doug Ingold and Warren Underwood, who on behalf of the Transportation Development Centre and the Federal Aviation Administration, have participated, contributed and provided guidance in the preparation of these documents.

PROJECT ACKNOWLEDGEMENTS

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

16. Abstract

This objective was met by conducting a series of full-scale tests using the National Research Council Canada (NRC) open-circuit wind tunnel to examine the flow-off properties of anti-icing fluids contaminated with various forms of simulated freezing precipitation to investigate several recent industry operational concerns; this work was completed in conjunction with the ice pellet research being conducted at the NRC Propulsion Icing Wind Tunnel.

- EVALUATION OF AN AIRFOIL PERFORMANCE MONITOR (APM): The testing conducted provided Marinvent with a platform for evaluating the APM unit, the details of which remain internal to Marinvent. Initial observations saw fluid get into the pressure probes of the APM unit; however, the extent of the effects should be further investigated by the manufacturer. Future testing should be done with a wireless unit to minimize aerodynamic effects of passing wires over the wing.
- AERODYNAMIC TESTING OF ICE PHOBIC COATINGS: A broader test plan was developed and conducted during the winter of 2012-13 to investigate some additional areas to gain some new insight into the potential applications of these coatings for aircraft operations, and to continue the research to include newly developed coating formulations. As part of this test plan, it was recommended that testing continue to investigate the effects of these coatings on de/anti-icing fluids from a holdover time and aerodynamic perspective.
- EFFECT OF FLUID VISCOSITY ON AERODYNAMIC FLUID-FLOW OFF PERFORMANCE: In general, the lift losses with mid-production fluid were slightly higher as compared to the lowest on-wing viscosity fluid results; these results seem more prominent in the case of fluid and contamination as compared to fluid only.

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

Plusieurs rapports de recherche sur des essais de technologies de dégivrage et d'antigivrage ont été produits au cours des hivers précédents pour le compte de Transports Canada. Ils sont disponibles auprès du Centre de développement des transports. Plusieurs rapports ont été rédigés dans le cadre du programme de recherche de cet hiver. Leur objet apparaît à l'avant-propos. Les travaux décrits dans ce rapport ont été en partie coparrainés par la Federal Aviation Administration.

16. Résumé

Cet objectif a été atteint en réalisant une série d'essais pleine grandeur dans la soufflerie à circuit ouvert du Conseil national de recherches Canada (CNRC) visant à examiner les propriétés de ruissellement de liquides d'antigivrage contaminés par diverses formes de précipitations givrantes simulées dans le but d'étudier de récentes préoccupations opérationnelles du secteur. Les travaux ont été réalisés en même temps que la recherche sur les granules de glace menée dans la soufflerie de givrage à propulsion du CNRC.

- ÉVALUATION D'UN MONITEUR DE PERFORMANCE DU PROFIL D'AILE (APM) : Les essais réalisés ont fourni à Marinvent une plateforme lui permettant d'évaluer l'APM, dont les détails ont été conservés à l'interne. Les premières observations ont révélé que du liquide s'introduisait dans les sondes de pression de l'APM ; la portée des effets devrait toutefois être étudiée davantage par le fabricant. D'autres essais devraient être réalisés avec un dispositif sans fil afin de réduire au minimum les effets aérodynamiques causés par les fils qui passent par-dessus les ailes.
- ESSAIS AÉRODYNAMIQUES SUR LES REVÊTEMENTS GLACIOPHOBES : Un plan d'essais plus vaste a été conçu et mis en œuvre au cours de l'hiver 2012-2013 dans le but d'étudier d'autres facteurs et d'obtenir de nouveaux renseignements sur les possibles applications de ces revêtements pour la navigation aérienne, ainsi que pour continuer les recherches de façon à inclure les formulations de revêtement nouvellement développées. Dans le cadre de ce plan, il a été recommandé de poursuivre les essais afin d'étudier les effets de tels revêtements sur les liquides de dégivrage et d'antigivrage du point de vue des durées d'efficacité et de l'aérodynamisme.
- EFFET DE LA VISCOSITÉ DU LIQUIDE SUR LA PERFORMANCE AÉRODYNAMIQUE DE RUISSELLEMENT : En général, les pertes de portance constatées avec le liquide de production intermédiaire étaient légèrement plus élevées que celles constatées avec le liquide à faible viscosité ; ces résultats sont plus évidents avec le liquide contaminé comparativement au liquide seul.

17. Mots clés Granule de glace, marge de tolérance, adhérence de liquide, écoulement de liquide, soufflerie, glaciophobes, précipitation mixte, neige sur une aile non protégée, neige lourde, viscosité		18. Diffusion Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.		
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EXECUTIVE SUMMARY

Background

Under contract to the Transportation Development Centre (TDC), with financial support from the Federal Aviation Administration (FAA), APS Aviation Inc. (APS) has undertaken research activities to further advance aircraft ground de/anti-icing technology. APS conducted a series of full-scale tests in the National Research Council Canada (NRC) 3 m x 6 m Open-Circuit Propulsion Icing Wind Tunnel (PIWT) to determine the flow-off characteristics of anti-icing fluid with and without simulated frozen precipitation contamination.

As a result of the large fixed costs associated with the aerodynamic portion of the research, and to benefit from economies of scale, Transport Canada (TC) and the FAA opted to conduct a series of tests to investigate other areas of research of interest to industry which may address operational concerns. This work was completed in conjunction with the ice pellet research being conducted at the NRC PIWT. Details of the 2012-13 ice pellet allowance time related research as well as the wind tunnel and wing calibration and characterization can be found 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* (Vol. 5) (1)

Evaluation of an Airfoil Performance Monitor (APM)

The testing conducted provided Marinvent with a platform for evaluating the APM unit, the details of which remain internal to Marinvent. Initial observations saw fluid enter the pressure probes of the APM unit; the effects of fluid intrusion should be further investigated by the manufacturer. Future testing should be done with a wireless unit to minimize aerodynamic effects of wires passed over the wing.

Aerodynamic Testing of Ice Phobic Coatings

A broader test plan was developed and conducted during the winter of 2012-13 to investigate some additional areas to gain some new insight into the potential applications of these coatings for aircraft operations, and to continue the research to include newly developed coating formulations. As part of this test plan, it was recommended that testing continue to investigate the effects of these coatings on de/anti-icing fluids from a holdover time and aerodynamic perspective. For ease of reference and due to relevance to the other subject matters, the results specific to this Propulsion Icing Wind Tunnel (PIWT) work have been included in a separate related report specific to coatings. Details are provided in an interim report, which was provided to TC and the FAA. A final report is expected to be published once the research is completed in a future winter.

Effect of Fluid Viscosity on Aerodynamic Fluid Flow-Off Performance

In general, the lift losses with mid-production fluid were slightly higher compared to the lowest on-wing viscosity (LOWV) fluid results; these results seem more prominent in the case of fluid and contamination compared to fluid-only. In the case of ABC-S Plus, the opposite trend was observed which was counter-intuitive.

Based on these results, the trends observed with mid-production fluid will be the same as those with LOWV. For ice pellet allowance time testing where comparative lift loss scaling is used for evaluation, the effects of fluid viscosity will be negated so long as the same level of fluid viscosity (mid or LOWV) is used. However, these results also indicate that difference in year-to-year fluid viscosities may cause some variation in the repeatability of the results, and consequently leading to some scatter in the lift-loss scaling correlation.

SOMMAIRE

Contexte

Dans le cadre d'un contrat avec le Centre de développement des transports (CDT) et avec l'appui financier de la Federal Aviation Administration (FAA), APS Aviation Inc. (APS) a entrepris des activités de recherche visant à faire progresser les technologies associées au dégivrage et à l'antigivrage d'aéronefs au sol. APS a mené une série d'essais pleine grandeur dans la soufflerie de givrage à propulsion et à circuit ouvert de 3 m sur 6 m du Conseil national de recherches Canada (CNRC) afin de déterminer les caractéristiques de ruissellement du liquide d'antigivrage avec et sans contamination par des précipitations gelées simulées.

En raison des importants coûts fixes associés à la partie aérodynamique de la recherche et pour profiter des économies d'échelle, Transports Canada (TC) et la FAA ont décidé de mener une série d'essais préliminaires afin d'étudier plusieurs préoccupations opérationnelles récentes du secteur. Ces travaux ont été réalisés en même temps que la recherche sur les granules de glace menée dans la soufflerie de givrage à propulsion du CNRC. Les résultats des essais menés en 2012-2013 sur les marges de tolérance dans des conditions de granules de glace, de même que les résultats des essais menés en soufflerie et sur l'étalonnage et la caractérisation des ailes, se trouvent dans le rapport de TC, 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* (Vol. 5) (1).

Évaluation d'un moniteur de performance du profil d'aile (APM)

Les essais réalisés ont fourni à Marinvent une plateforme lui permettant d'évaluer l'APM, dont les détails ont été conservés à l'interne. Les premières observations ont révélé que du liquide s'introduisait dans les sondes de pression de l'APM ; la portée des effets devrait toutefois être étudiée davantage par le fabricant. D'autres essais devraient être réalisés avec un dispositif sans fil afin de réduire au minimum les effets aérodynamiques causés par les fils qui passent par-dessus les ailes.

Essais aérodynamiques sur les revêtements glaciophobes

Un plan d'essais plus vaste a été conçu et mis en œuvre au cours de l'hiver 2012-2013 dans le but d'étudier d'autres facteurs et d'obtenir de nouveaux renseignements sur les possibles applications de ces revêtements pour la navigation aérienne, ainsi que pour continuer les recherches de façon à inclure les formulations de revêtement nouvellement développées. Dans le cadre de ce plan, il a été

recommandé de poursuivre les essais afin d'étudier les effets de tels revêtements sur les liquides de dégivrage et d'antigivrage du point de vue des durées d'efficacité et de l'aérodynamisme. Par souci de commodité et étant donné leur pertinence pour les autres sujets, les résultats se rapportant précisément aux travaux menés dans la soufflerie de givrage à propulsion ont été inclus dans un rapport distinct portant sur les revêtements. Les détails figurent dans un rapport provisoire, lequel a été transmis à TC et à la FAA. Une version définitive devrait être publiée une fois la recherche terminée, dans un hiver à venir.

Effet de la viscosité du liquide sur la performance aérodynamique de ruissellement

En général, les pertes de portance constatées avec le liquide de production intermédiaire étaient légèrement plus élevées que celles constatées avec le liquide à faible viscosité ; ces résultats sont plus évidents avec le liquide contaminé comparativement au liquide seul. En ce qui concerne le liquide ABC-S Plus, la tendance contraire a été observée, ce qui va à l'encontre du sens commun.

À la lumière de ces résultats, les tendances observées avec le liquide de production intermédiaire seront les mêmes que celles associées au liquide à faible viscosité. Pour les essais sur les marges de tolérance dans des conditions de granules de glace où une échelle comparative des pertes de portance est utilisée à des fins d'évaluation, les effets de la viscosité des liquides seront annulés tant que le même niveau de viscosité (modéré ou faible) est utilisé. Cependant, ces résultats laissent aussi entendre qu'une différence de viscosité d'une année à l'autre peut entraîner certaines variations dans la répétabilité des résultats et, par conséquent, causer une certaine dispersion des données concernant la corrélation avec l'échelle des pertes de portance.

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GLOSSARY

APM	Airfoil Performance Monitor
APS	APS Aviation Inc.
CEF	Climatic Engineering Facility
FAA	Federal Aviation Administration
HOT	Holdover Time
LOWV	Lowest On-Wing Viscosity
MSC	Meteorological Service of Canada
NRC	National Research Council Canada
OAT	Outside Air Temperature
PIWT	3 m x 6 m Open-Circuit Propulsion Icing Wind Tunnel
TC	Transport Canada
TDC	Transportation Development Centre

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1. INTRODUCTION

Under winter precipitation conditions, aircraft are cleaned with a freezing point depressant fluid and protected against further accumulation by an additional application of such a fluid, possibly thickened to extend the protection time. Aircraft ground deicing had, until recently, never been researched and there is still an incomplete understanding of the hazard and of what can be done to reduce the risks posed by the operation of aircraft in winter precipitation conditions. This "winter operations contaminated aircraft – ground" program of research is aimed at overcoming this lack of knowledge.

Since the early 1990s, the Transportation Development Centre (TDC) of Transport Canada (TC) has managed and conducted de/anti-icing related tests at various sites in Canada; it has also coordinated worldwide testing and evaluation of evolving technologies related to de/anti-icing operations with the co-operation of the United States Federal Aviation Administration (FAA), the National Research Council Canada (NRC), the Meteorological Service of Canada (MSC), several major airlines, and deicing fluid manufacturers. The TDC is continuing its research, development, testing and evaluation program.

Under contract to the TDC, with financial support from the FAA, APS Aviation Inc. (APS) has undertaken research activities to further advance aircraft ground de/anti-icing technology.

1.1 Background

Due to the recent industry requirement for guidance material for aircraft operations in mixed precipitation conditions with ice pellets, APS conducted a series of plate tests in the NRC Climatic Engineering Facility (CEF) and full-scale aerodynamic testing in the NRC 3 m x 6 m Open-Circuit Propulsion Icing Wind Tunnel (PIWT) and with the NRC Falcon 20 aircraft. This ongoing research was conducted during the winters of 2005-06 to 2012-13 to characterize fluid failure mechanisms, to determine the flow-off properties of anti-icing fluid contaminated with mixed conditions including ice pellets, and to substantiate and possibly expand the newly developed ice pellet allowance times.

As a result of the large fixed costs associated with the aerodynamic portion of the research, and to benefit from economies of scale, TC and the FAA opted to conduct a series of tests to investigate other research areas of interest to industry that may address operational concerns. This work was completed in conjunction with the ice pellet research being conducted at the NRC PIWT. Details of the 2012-13 ice pellet allowance time related research, as well as the wind tunnel and wing calibration and characterization, can be found 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* (Vol. 5) (1).

1.2 Previous Reports

Reports describing the research and development objectives conducted in previous years in the NRC wind tunnel have been compiled and are available. In 2008-09, 2009-10, and 2010-11, comprehensive reports describing the R&D objectives were compiled and can be referenced as:

- TC report, TP 14939E, *Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2008-09* (2);
- TC report, TP 15057E, *Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2009-10* (3); and
- TC report, TP 15160E, *Exploratory Wind Tunnel Aerodynamic Research: Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2010-11* (4).

In 2006-07, a feasibility report describing the potential for using the wind tunnel and the Falcon 20 aircraft for R&D testing initiatives was compiled and can be referenced as TC report, TP 14778E, *Flow of Contaminated Fluid from Aircraft Wings: Feasibility Report* (5).

1.3 Program Objectives

Full-scale testing during the winter of 2012-13 was conducted using the NRC PIWT. The primary testing conducted aimed at validating the current allowance times for use with newer generation aircraft with thin, high-performance wing designs, as well as to complete the wind tunnel and wing calibration and characterization.

As part of this larger research program, APS conducted some additional testing during the winter of 2012-13 to investigate several areas of research. Aerodynamic testing was conducted in conjunction with the ice pellet allowance time research program. Research was conducted to satisfy the following objectives:

- Evaluation of an airfoil performance monitor (APM);
- Evaluation of ice phobic coatings with and without fluid; and

- Evaluation of the effect of fluid viscosity on aerodynamic fluid flow-off performance.

The results from this work are reported in Sections 2 to 4 of this report. The work statement for these tests is provided in Appendix A.

1.4 Overview of 2012-13 Testing

Table 1.1 demonstrates the groupings for the set of tests conducted at the wind tunnel during the winter of 2012-13. Only the tests related to the effect of viscosity on fluid flow-off, ice phobic coatings, and the APM are described in this report.

Table 1.1: Summary of 2012-13 Wind Tunnel Testing

Objective	# of Runs
Wing and tunnel characterization*	125
Ice pellet allowance times	40
Ice phobic coatings	40
Airfoil performance monitor	8
Total	***213***

* Includes 9 tests related to the effect of viscosity on fluid flow-off

1.5 General Methodology

To satisfy the program objective, simulated takeoff and climb-out tests were performed with the thin, high-performance wing section, and 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 specifically to conduct these tests following extensive consultations with an airframe manufacturer to ensure a representative thin, high-performance design was used.

The typical procedure for each test was as follows:

a) The wing section was treated with anti-icing fluid, poured in a one-step operation;

b) Contamination, in the form of simulated ice pellets, freezing rain, and snow, was applied to the wing section. Test parameters were measured at the beginning and end of the exposure to contamination;

c) At the end of the contamination period, the tunnel was cleared of all equipment and scaffolding;

d) The wind tunnel was subsequently operated through a simulated takeoff and climb-out test; and

e) 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 procedure for the wind tunnel tests is included in Appendix B. The procedure includes details regarding the test objectives, test plan, procedure and methodology, and pertinent information and documentation.

This general methodology was modified as necessary to satisfy the individual test objectives. Deviation from this methodology will be described in the individual test results sections.

1.6 General Analysis Methodology

A thorough and extensive analysis methodology has been developed and applied for the ice pellet allowance time testing. This is described in TP 15232E (Vol. 5) (1). This analysis methodology has been applied when applicable for analysing the tests described in this report.

Typically, each test is analysed in detail using the following objectives:

a) Test parameters;

b) Visual ratings at the start of the test;

c) Visual ratings at rotation;

d) 8° rotation lift loss; and

e) Overall test status.

The evaluation grades for each criterion were “good,” “review,” or “bad.” These grades were determined based on whether the criteria satisfied each test objective requirement. Figure 1.1 shows a summary of each test objective and criteria. These evaluation criteria were applied as necessary to the analysis of the tests described in this report.

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 1.1: Wind Tunnel Test Analysis Criteria

1.7 General Data

For documentation purposes, data that was collected during the wind tunnel tests has been included in this report regardless of whether or not the information was used for analysis. Completed wing temperature, fluid thickness, and fluid Brix data forms have been included in Appendix C. High-speed digital photography of each test, as well as video in some cases, was taken. However, due to the large amount of data available, photos of the individual tests have not been included in this report, but rather the high-resolution photos are in electronic format and have been made available to the TDC and can be seen upon request.

1.8 Report Format

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

a) Section 2 describes the data, results, and observations for the evaluation of the APM;

b) Section 3 describes the data, results, and observations for the ice phobic coatings testing with and without fluid; and

c) Section 4 describes the data, results, and observations for the effect of fluid viscosity on aerodynamic fluid flow-off performance tests.

2. EVALUATION OF AN AIRFOIL PERFORMANCE MONITOR

2.1 Background

APMs are being developed and can be installed on any airfoil on an aircraft, including the tail. An APM is designed to measure the airflow over the wing, which reveals how well the wing is working. As a wing becomes contaminated, the APM should measure the changing or turbulent airflow and resulting lift generated by the wing. The APM is designed to alert the crew if the airflow degrades below a configurable threshold, giving the crew time to correct a potential stall before it happens. It was recommended that testing be conducted with a Canadian-developed APM to support the development of the technology, to aid in evaluating the potential for use in ground icing operations, and to investigate whether or not the use of fluids with the systems would potentially obstruct the pressure ports critical to the systems' operation. The APM unit was provided by Marinvent.

2.2 Objective

To provide a testing platform to the manufacturer and allow them to evaluate the ability of the APM to properly identify stall with and without icing conditions during aircraft ground operations with de/anti-icing fluid applications.

2.3 General Methodology

The APM unit was mounted onto the trailing edge of the wing section using a screw and pre-existing threaded holes, along with speed tape. The unit was wired into the NRC data acquisition systems, and data was collected in real-time during each test.

The following is a brief summary of the methodology used for this testing; the general testing procedures were in line with the typical wind tunnel testing procedures used at the NRC PIWT:

- Conduct dry wing baseline testing with and without the installation to understand any potential aerodynamic influences the sensor may have;
- With the sensor installed, conduct dry wing tests to stall;
- Repeat tests with fluid only to stall;
- Evaluate ability of the APM to measure stall and compare to the stall observed through the aerodynamic data collected; and
- Evaluate the use of the APM unit with fluids.

2.4 Data Collected

Eight tests were conducted, dry and with fluid. During Tests #53-56, the APM unit was installed with a shim. It was believed that this shim raised the sensor slightly above the boundary layer, so the shim was removed for Tests #57-59. A summary of the test data is included in Table 2.1.

2.5 Summary of Test Results

The aerodynamic impact of the installation of the APM sensor alone caused an increase in lift loss, primarily attributed to the cabling required to hard-wire the APM unit to the NRC acquisition systems. This cabling was speed-taped to the top of the wing surface (see Photo 2.1), causing some significant aerodynamic effects: close to 3 percent lift loss compared to the dry wing in some cases. Future testing should consider using a wireless system to avoid this adverse effect.

The data collected was interpreted by the APM manufacturer using their own specially developed algorithms for interpreting the stall data. As such, the detailed analysis was performed by Marinvent. The main purpose of TC involvement was to provide a testing platform to encourage the development of the technology.

Table 2.1: Summary of 2012-13 Airfoil Performance Monitor Wind Tunnel Tests

Test Year	Test #	Date	Objective	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Extra Run Information	**Corrected for 3D Effects** % Lift Loss On 8° Cl vs Dry Cl	Tunnel Temp. Before Test (°C)	Fluid Amount (L)	OAT Before Test (°C)
Winter 2012-13	**52**	8-Jan-13	Evaluation of Stallwarning Sensor	None	None	Stall	80	Dry wing baseline prior to installing sensor	0.15%	-	-	-
SENSOR INSTALLED WITH SHIM												
Winter 2012-13	**53**	8-Jan-13	Evaluation of Stallwarning Sensor	None	None	Stall	80	Dynamic stall	1.94%	11.6	-	0.7
Winter 2012-13	**54**	8-Jan-13	Evaluation of Stallwarning Sensor	None	None	Stall	80	Pitch pause run	1.28%	10	-	1
Winter 2012-13	**55**	8-Jan-13	Evaluation of Stallwarning Sensor	Fluid Only	Type I EG	Stall	80	Type I fluid test	2.48%	3	10	2.8
Winter 2012-13	**56**	8-Jan-13	Evaluation of Stallwarning Sensor	Fluid Only	EG106	Stall	80	Type IV fluid test	5.20%	2.9	16	3.1
FLUSH MOUNTED SENSOR INSTALLED												
Winter 2012-13	**57**	8-Jan-13	Evaluation of Stallwarning Sensor	None	None	Stall	80	Dynamic stall	2.93%	3	-	2.1
Winter 2012-13	**58**	8-Jan-13	Evaluation of Stallwarning Sensor	None	None	Stall	80	Pitch pause run	1.85%	3	-	2.1
Winter 2012-13	**59**	8-Jan-13	Evaluation of Stallwarning Sensor	Fluid Only	EG106	Stall	80	Type IV fluid test	4.38%	2.8	16	1.9

Although the detailed analysis was conducted by Marinvent and will not be presented, the raw data collected for the APM's upper and lower pressure probes for each of the eight tests conducted was obtained by the NRC. The NRC then used this data to calculate the ratio of the turbulence subtracted from the mean value of the signal and divided by the mean value of the signal. Essentially, a higher value represents more turbulence measured by the sensor probes. This data (shown in Figures 2.1 and 2.2) has been provided in this report for reference purposes; however, no conclusions regarding the proficiency in detecting stall have been drawn, as this information is still preliminary.

As a general observation, fluid was observed in the pressure ports of the sensor unit following fluid tests (see Photo 2.2). Although this was not expected to significantly affect the performance of the APM unit (according to Marinvent), this should be further investigated in light of potential residue problems or clogging issues.

2.6 General Observations

The testing conducted provided Marinvent with a platform for evaluating the APM unit, the details of which remain privileged to Marinvent. Initial observations saw fluid enter the pressure probes of the APM unit; the effects of fluid intrusion should be further investigated by the manufacturer. Future testing should be done with a wireless unit to minimize aerodynamic effects of wires installed on the wing surface.

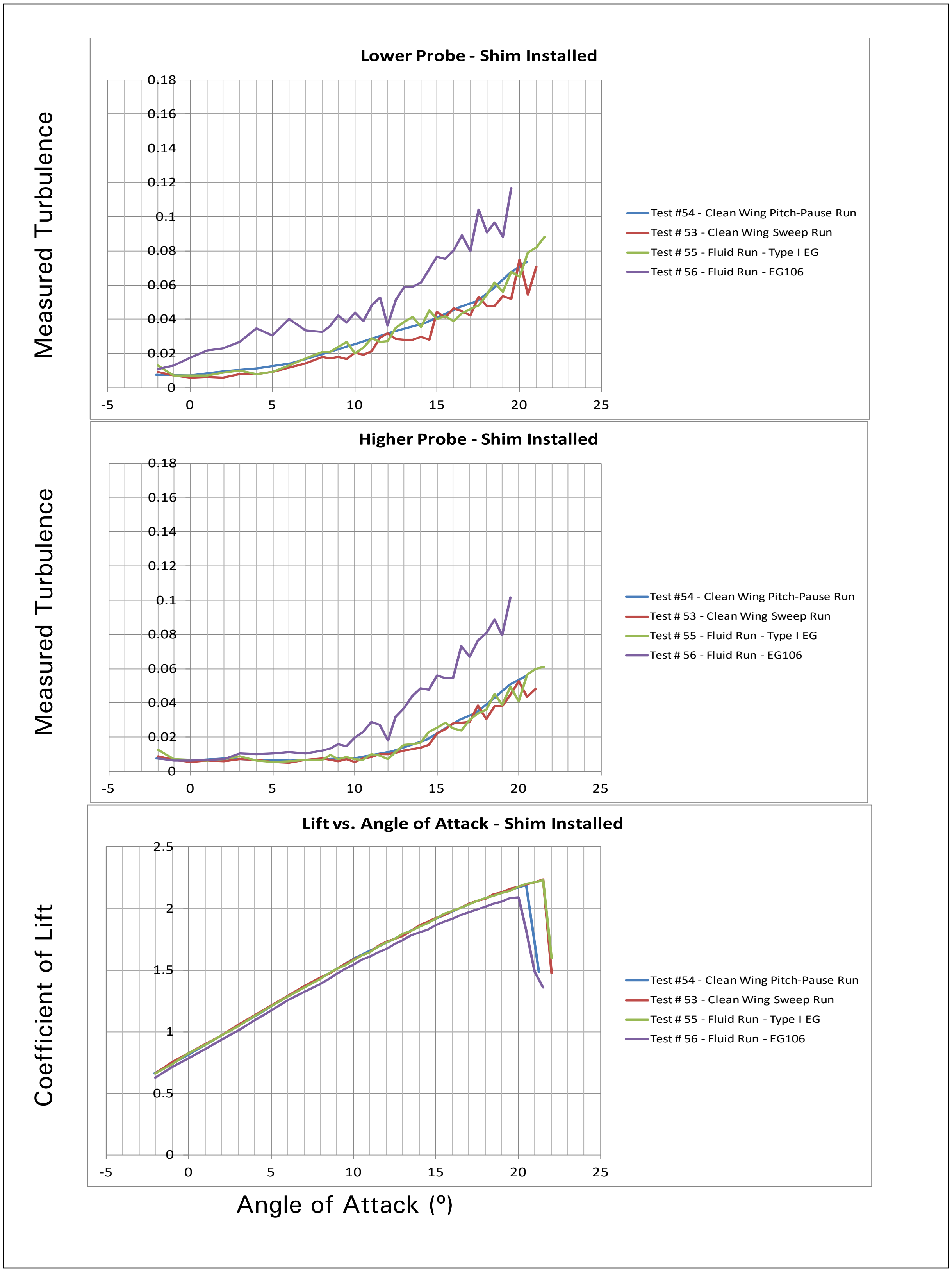


Figure 2.1: Sensor Data with Shim Installed

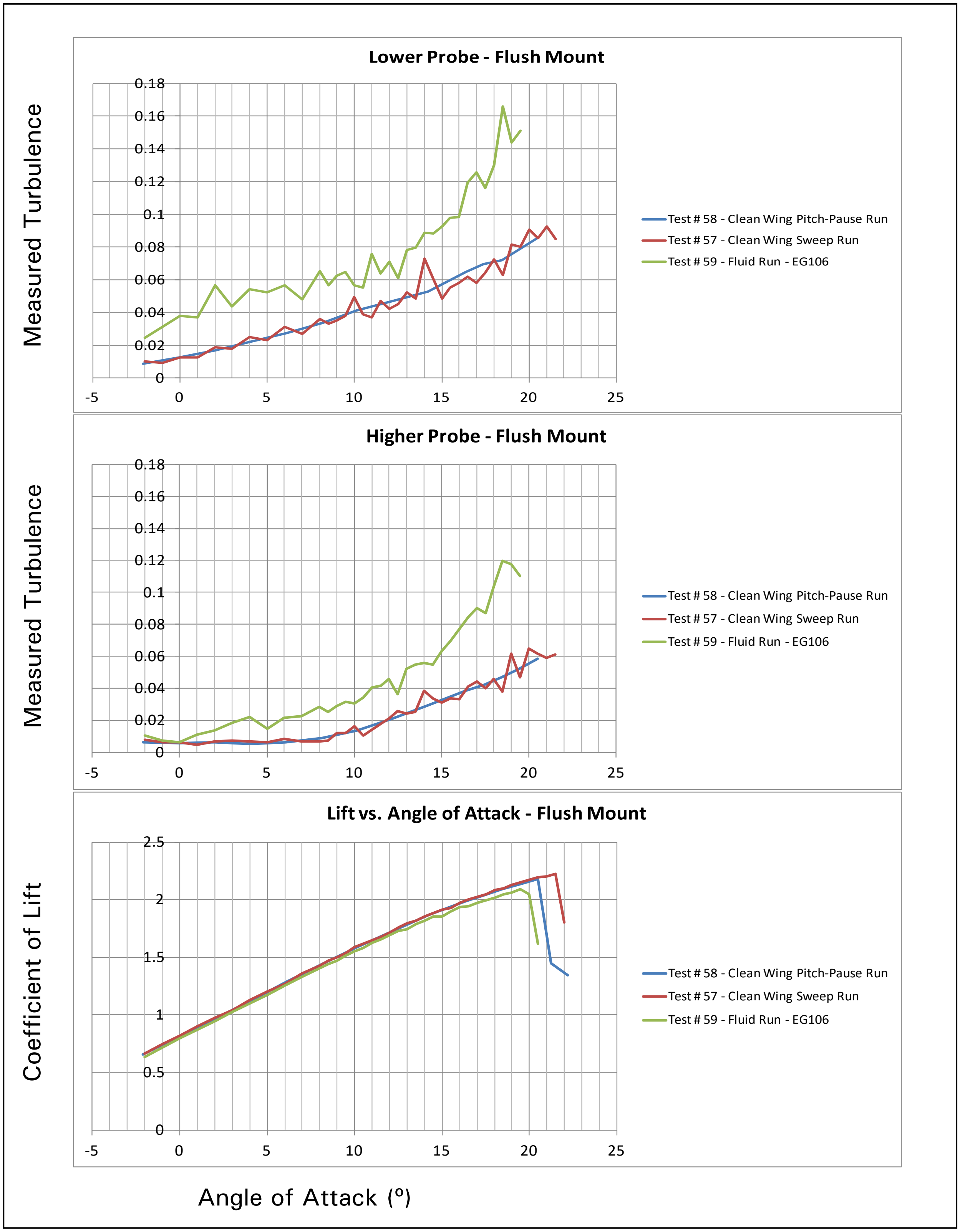


Figure 2.2: Flush-Mounted Sensor Data

Photo 2.1: Installation of APM Unit with Cable Speed-Taped to Wing

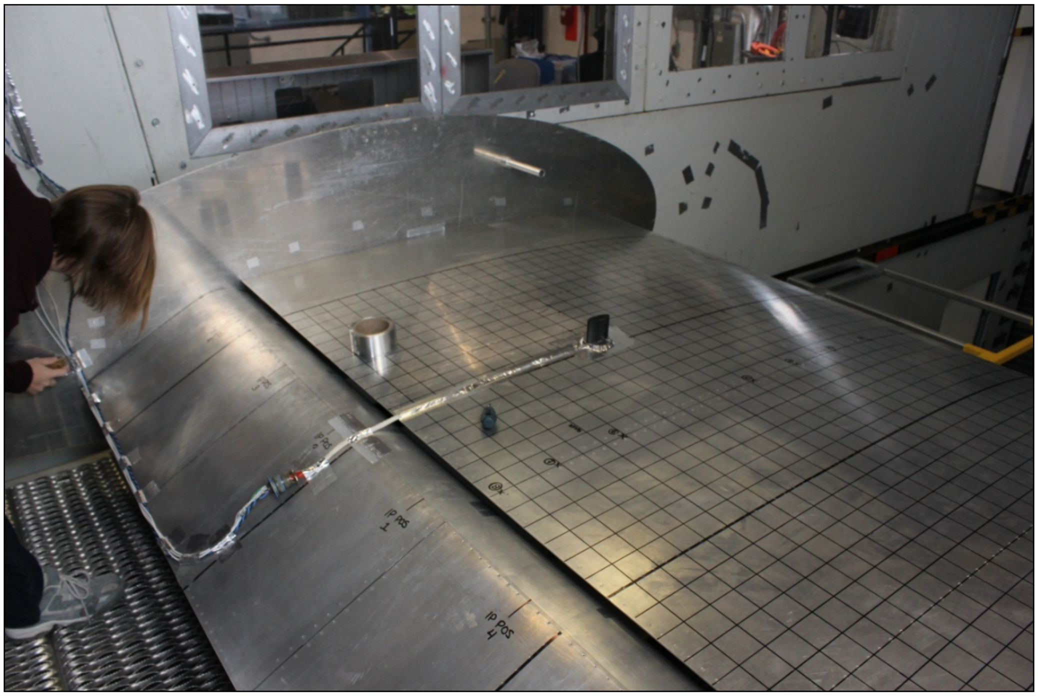
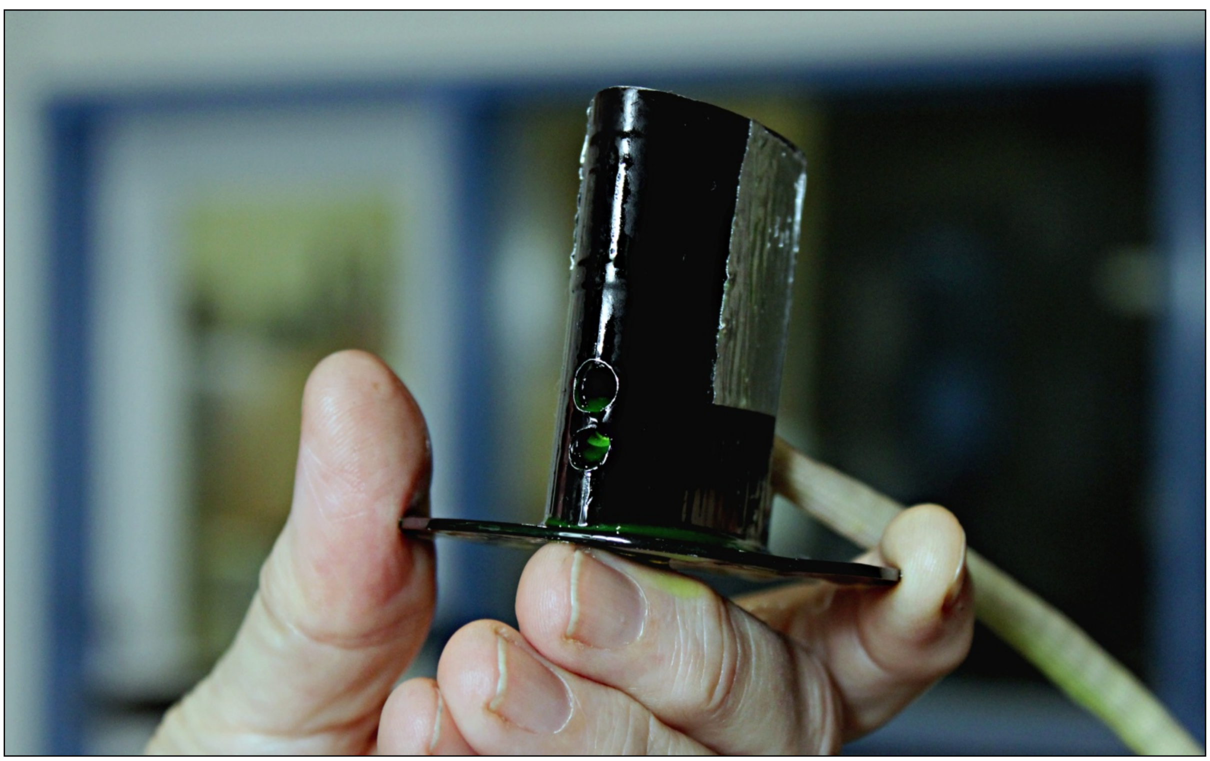


Photo 2.2: Fluid in Pressure Ports of APM Unit Following Fluid Test



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3. AERODYNAMIC TESTING OF ICE PHOBIC COATINGS

3.1 Background

Ice build-up on aircraft is a major safety concern for both on-ground and in-flight aircraft operations. In recent years, there has been significant industry interest in the use of coatings to protect aircraft critical surfaces. Some recent work has studied these coatings (sometimes designed and marketed as ice phobic coatings) during in-flight operations, but the behaviour and performance of these coatings during ground icing operations has yet to be fully investigated.

A broader test plan was developed and conducted during the winter of 2012-13 to investigate some additional areas to gain some new insight into the potential applications of these coatings for aircraft operations and to continue the research to include newly developed coating formulations. As part of this test plan, it was recommended that testing continue to investigate the effects of these coatings on de/anti-icing fluids from a holdover time (HOT) and aerodynamic perspective. For ease of reference and due to relevance to the other subject matters, the results specific to this Propulsion Icing Wind Tunnel (PIWT) work have been included in a separate, related report specific to coatings. The research on ice phobic technologies was documented in an interim report, which was provided to TC and the FAA. A final report is expected to be published once the research is completed in a future winter.

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4. EFFECT OF FLUID VISCOSITY ON AERODYNAMIC FLUID FLOW-OFF PERFORMANCE

4.1 Background

Testing was conducted to evaluate the aerodynamic effects of fluid viscosity on flow-off. To do so, comparative testing was conducted with both mid-production fluid (used for ice pellet allowance time testing) and with lowest on-wing viscosity (LOWV) fluid (used for HOT testing). Testing was conducted with the thin, high-performance airfoil in both fluid only and contaminated fluid conditions.

4.2 Objective

The objective of this test was to investigate the aerodynamic effects of fluid viscosity on flow-off.

4.3 General Methodology

The general methodology used for these tests was in accordance with the methodologies used for typical fluid and fluid/contamination tests conducted in the wind tunnel. The evaluation methodology was modified to allow a comparison of the fluid viscosity effects. For each comparative test set, a baseline mid-production test was conducted and immediately followed by a LOWV test of the same fluid type.

4.4 Data Collected

In total, 16 tests were conducted for a total of 8 comparative test runs. A summary of the test data is included in Table 4.1. The viscosity results of the fluids tested are included in Table 4.2.

Table 4.1: Log of 2012-13 Effect of Fluid Viscosity Testing

Test Year	Test #	Date	Objective	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Corrected for 3D Effects CL at 8°	Corrected for 3D Effects % Lift Loss on 8° CL vs. Dry CL	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	Exposure Time (min.)
Winter 2012-13	135	23-Jan-13	Baseline (BLDT)	Fluid Only	AD-49	8	100	20	1.408	3.99%	-22.6	-5	-	-	-
Winter 2012-13	136	23-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	AD-49	8	100	20	1.417	3.37%	-22.8	-24.9	-	-	-
Winter 2012-13	138	24-Jan-13	Baseline (BLDT)	Fluid Only	ABC-S Plus	8	100	20	1.395	4.83%	-22.4	-25.2	-	-	-
Winter 2012-13	139	24-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	ABC-S Plus	8	100	20	1.386	5.46%	-22.7	-25.4	-	-	-
Winter 2012-13	143	24-Jan-13	Baseline (BLDT)	Fluid Only	Max-Flight	8	100	20	1.375	6.21%	-23.1	-25.4	-25.4	-	-
Winter 2012-13	144	24-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	Max-Flight	8	100	20	1.379	5.96%	-23.1	-25.2	-	-	-
Winter 2012-13	149	24-Jan-13	IP Flow-Off Issues	IP mod	Polar Guard Advance	8	115	20	1.331	9.24%	-17.2	-19.7	75	-	10
Winter 2012-13	150	24-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	Polar Guard Advance	8	115	20	1.3 69	6.65%	-17.1	-20	75	-	10
Winter 2012-13	152	25-Jan-13	Baseline (BLDT)	Fluid Only	Polar Guard Advance	8	115	20	1.389	5.25%	-17.4	-20.3	-	-	-
Winter 2012-13	153	25-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	Polar Guard Advance	8	115	20	1.399	4.54%	-17.3	-20.4	-	-	-
Winter 2012-13	156	25-Jan-13	IP Flow-Off Issues	IP mod	Launch	8	115	20	1.333	9.06%	-16.8	-21.1	75	-	10

Table 4.1: Log of 2012-13 Effect of Fluid Viscosity Testing (cont'd)

Test Year	Test #	Date	Objective	Test Condition	Fluid Name	Rotation Angle	Speed (Kts)	Flap Angle (0°, 20°)	Corrected for 3D Effects CL at 8°	Corrected for 3D Effects % Lift Loss on 8° CL vs. Dry CL	Tunnel Temp. Before Test (°C)	OAT Before Test (°C)	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	Exposure Time (min.)
Winter 2012-13	157	25-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	Launch	8	100	20	1.370	6.53%	-17.4	-21.2	-	-	-
Winter 2012-13	163	27-Jan-13	IP Validation with New Fluids	IP mod	ABC-S Plus	8	100	20	1.374	6.27%	-3.8	-11.8	75	-	15
Winter 2012-13	164	27-Jan-13	Effect of Viscosity on Fluid Aerodynamics	IP mod	ABC-S Plus	8	100	20	1.366	6.79%	-4.9	-11.2	75	-	15
Winter 2012-13	171	28-Jan-13	IP Validation with New Fluids	IP- / SN-	AD-49	8	100	20	1.355	7.54%	-5.4	-11.8	25	10	25
Winter 2012-13	172	28-Jan-13	Effect of Viscosity on Fluid Aerodynamics	Fluid Only	AD-49	8	100	20	1.376	6.15%	-5.6	-12	25	10	25

4.5 Summary of Test Results

The comparative test results have been presented in an abbreviated table format in Table 4.3. The results indicate that the lift losses recorded with mid-production fluid were on average 0.9 percent higher compared to the LOWV fluid tests with a maximum of 2.69 percent. The results were separated by fluid only and fluid/contamination in Tables 4.4 and 4.5. These results indicate that the effect of fluid viscosity may be more prominent for contaminated fluid cases than for the fluid only tests, with an average difference of 0.29 percent for fluid only versus 1.59 percent for contaminated fluid. In the case of ABC-S Plus, both fluid only and contaminated fluid showed better aerodynamic performance with the mid-production fluid, which is counterintuitive to the expected results, particularly for the fluid only case.

4.6 General Observations

In general, the lift losses with mid-production fluid were slightly higher compared to the LOWV fluid results; these results seem more prominent in the case of contaminated fluid compared to fluid only. In the case of ABC-S Plus, the opposite trend was observed, which was counterintuitive.

Based on these results, the trends observed with mid-production fluid will be the same as those with LOWV. For ice pellet allowance time testing where comparative lift loss scaling is used for evaluation, the effects of fluid viscosity will be negated so long as the same level of fluid viscosity (mid or LOWV) is used. However, these results also indicate that differences in year-to-year fluid viscosities may cause some variation in the repeatability of the results, consequently leading to some scatter in the lift-loss scaling correlation.

Table 4.2: Brookfield Fluid Viscosity Measured using Manufacturer Method

Fluid Name	Fluid Type	Batch #	Fluid Viscosity (cP)
AD-49	Mid-Production	L12-328	14,397
AD-49	LOWV	L12-331	8,898
ABC-S Plus	Mid-Production	WT.12.13.ABC-S+	19,996
ABC-S Plus	LOWV	WT.12.13.ABC-S+-LOWV	10,498
Launch	Mid-Production	USHA039555	13,997
Launch	LOWV	DEG 4 146139	6,839
Max-Flight	Mid-Production	U49E001966	11,658
Max-Flight	LOWV	U49E001966 (LOWV)	5,019
Polar Guard Advance	Mid-Production	13342	15,200
Polar Guard Advance	LOWV	13102	3,800

Table 4.3: Difference in Lift Loss Results for All Tests

Test #	Test Condition	Fluid Type	Fluid Name	% Lift Loss Compared to Dry Wing Calculated at 8º	Difference in Lift Loss (Mid - LOWV)
135	Fluid Only	Mid-Production	AD-49	3.99%	0.6%
136	Fluid Only	LOWV	AD-49	3.37%	
138	Fluid Only	Mid-Production	ABC-S Plus	4.83%	-0.6%
139	Fluid Only	LOWV	ABC-S Plus	5.46%	
143	Fluid Only	Mid-Production	Max-Flight	6.21%	0.2%
144	Fluid Only	LOWV	Max-Flight	5.96%	
149	IP mod	Mid-Production	Polar Guard Advance	9.24%	2.6%
150	IP mod	LOWV	Polar Guard Advance	6.65%	
152	Fluid Only	Mid-Production	Polar Guard Advance	5.25%	0.7%
153	Fluid Only	LOWV	Polar Guard Advance	4.54%	
156	IP mod	Mid-Production	Launch	9.06%	2.5%
157	IP mod	LOWV	Launch	6.53%	
163	IP mod	Mid-Production	ABC-S Plus	6.27%	-0.5%
164	IP mod	LOWV	ABC-S Plus	6.79%	
171	IP- / SN-	Mid-Production	AD-49	7.54%	1.4%
172	IP- / SN-	LOWV	AD-49	6.15%	

Average	0.9%
Standard Deviation	1.2%
Minimum	-0.6%
Maximum	2.6%

Table 4.4: Difference in Lift Loss Results for Fluid Only Tests

Test #	Test Condition	Fluid Type	Fluid Name	% Lift Loss Compared to Dry Wing Calculated at 8°	Difference in Lift Loss (Mid - LOWV)
135	Fluid Only	Mid-Production	AD-49	3.99%	0.6%
136	Fluid Only	LOWV	AD-49	3.37%	
138	Fluid Only	Mid-Production	ABC-S Plus	4.83%	-0.6%
139	Fluid Only	LOWV	ABC-S Plus	5.46%	
143	Fluid Only	Mid-Production	Max-Flight	6.21%	0.2%
144	Fluid Only	LOWV	Max-Flight	5.96%	
152	Fluid Only	Mid-Production	Polar Guard Advance	5.25%	0.7%
153	Fluid Only	LOWV	Polar Guard Advance	4.54%	

Average	0.2%
Standard Deviation	0.6%
Minimum	-0.6%
Maximum	0.7%

Table 4.5: Difference in Lift Loss Results for Fluid and Contamination Tests

Test #	Test Condition	Fluid Type	Fluid Name	% Lift Loss Compared to Dry Wing Calculated at 8°	Difference in Lift Loss (Mid - LOWV)
149	IP mod	Mid-Production	Polar Guard Advance	9.24%	2.6%
150	IP mod	LOWV	Polar Guard Advance	6.65%	
156	IP mod	Mid-Production	Launch	9.06%	2.5%
157	IP mod	LOWV	Launch	6.53%	
163	IP mod	Mid-Production	ABC-S Plus	6.27%	-0.5%
164	IP mod	LOWV	ABC-S Plus	6.79%	
171	IP- / SN-	Mid-Production	AD-49	7.54%	1.4%
172	IP- / SN-	LOWV	AD-49	6.15%	

Average	1.5%
Standard Deviation	1.5%
Minimum	-0.5%
Maximum	2.6%

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2. Ruggi, M., *Exploratory Wind Tunnel Aerodynamic Research Examination of Contaminated Anti-Icing Fluid Flow-Off Characteristics Winter 2008-09*, APS Aviation Inc., Transportation Development Centre, Montreal, March 2010, TP 14939E, XX (to be published).

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APPENDIX A

TRANSPORTATION DEVELOPMENT CENTRE
WORK STATEMENT EXCERPT –
AIRCRAFT & ANTI-ICING FLUID WINTER TESTING 2012-13

TRANSPORTATION DEVELOPMENT CENTRE
WORK STATEMENT EXCERPT –
AIRCRAFT & ANTI-ICING FLUID WINTER TESTING 2012-13

4.1 Wind Tunnel Testing

e) Perform wind tunnel tests to support the development of aircraft ground deicing related procedures and technologies;

   a. Testing to evaluate a stall sensor apparatus;

   b. Testing with a ROGIDS camera;

   c. Testing to address industry concerns and interests; and

f) Analyze the data collected, Report the findings, and prepare presentation material for the SAE G-12 meetings.

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APPENDIX B

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

CM2265.002

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

Winter 2012-13

Prepared for

Transportation Development Centre
Transport Canada

Prepared by: Marco Ruggi and Victoria Zoitakis

Reviewed by: John D'Avirro

January 3, 2013
Final Version 1.0

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

1. BACKGROUND

Prior to the winter of 2006-07, Holdover Time (HOT) guidance material did not exist for ice pellet conditions, however aircraft could still depart during ice pellet conditions following aircraft deicing and a pre take off contamination check. This protocol was feasible for common air carrier aircraft that provided access to emergency exit windows overlooking the leading edge of the aircraft wings; however, it posed a significant problem for cargo aircraft that have limited visibility of the wings from the cabin.

On December 22, 2004, United Parcel Service (UPS) aircraft in Louisville were grounded for several hours due to extended ice pellet conditions. Due to cargo aircraft configuration, pre-take off contamination checks by the on-board crew were not possible. FedEx had been faced with similar problems in Memphis. Following this event, in October 2005, the FAA issued two notices restricting take offs in ice pellet conditions.

As a result of this costly incident, UPS set out to obtain experimental data to provide guidance and allow operations to continue in ice pellet conditions. During the winter of 2004-05, aerodynamic and endurance time testing were conducted in simulated ice pellet conditions. APS also conducted some preliminary flat plate research (see TP 14718E). Based on the preliminary data, an allowance of 20 minutes in light ice pellet conditions was proposed, however no changes to the HOT guidelines were made.

During the following winter of 2006-07, the FAA provided a 25 minute allowance as a preliminary guideline; TC issued a note indicating that no changes would be made to the HOT guidelines. This allowance was based on the previous research conducted during the winter of 2005-06, primarily as a result of Falcon 20 aerodynamic research (see TP 14716E); these results were presented at the Society of Automotive Engineers (SAE) meeting in Lisbon in May 2006. To address the option of a pre-take off contamination check, the 20 minute targeted allowance was extended to 25 minutes; pre-take off contamination checks would no longer apply. This allowance was followed by a list of conditions; one restriction was that operations would be limited to ice pellets alone (no mixed conditions).

Due to the high occurrence of ice pellets combined with freezing rain or snow, the industry requested additional guidance material for operations in mixed ice pellet conditions. Additional endurance time testing and aerodynamic research were conducted in simulated ice pellet conditions during the winter of 2006-07.

During the winter of 2007-08, the TC and FAA provided allowance time guidance material for operations in mixed conditions with ice pellets guideline. These allowance times were based on the research conducted during the winter of 2006-07 (see TP 14779E). The recommended allowance times were based on aerodynamic research conducted using the 3 m x 6 m Open Circuit Propulsion and Icing Wind Tunnel (PIWT) and the NRC Falcon 20 aircraft; these results were presented at the SAE meeting in San Diego in May 2007. These allowance time guidelines were followed by a list of restrictions based on the results obtained through the research conducted, and the lack of data in specific conditions.

During the winter of 2008-09, additional endurance time testing and aerodynamic research was conducted to support and further expand the ice pellet allowance times (see TP 14935E). Full-scale testing with the NRC PIWT was conducted in mixed conditions with ice pellets and in non precipitation conditions. Testing was geared towards validating the current ice pellet allowance times, and potentially expanding the guidance material to include different conditions, fluids, and acceleration profiles. A revised version of the ice pellet allowance times was published for the winter of 2009-10; changes were made to the high speed table allowance times only.

During the winter of 2009-10, additional aerodynamic research using a generic super-critical wing model was conducted at the NRC PIWT to support and further expand the ice pellet allowance times for use with newer generation aircraft. During the testing, fluid flow-off issues with the supercritical wing were observed with PG fluids at the lower temperatures; more specifically during light ice pellets and moderate ice pellet conditions below -10°C. In addition fluid failure issues with the supercritical wing were observed with PG fluids during moderate ice pellets above -5°C; the relatively flat surface of the wing had less fluid flow off during contamination and resulted in an earlier fluid failure for PG fluids. In general, higher lift losses were observed with the supercritical wing as compared to previous wings tested. A revised version of the ice pellet allowance times was published for the winter of 2009-10. Additional analysis paired with wind tunnel testing was recommended for the winter of 2010-11 to develop a correlation between the lift losses observed in the wind tunnel and those used as the basis of the aerodynamic acceptance tests for fluid certification.

Results from the 2010-11 testing demonstrated similar results to the 2009-10 testing in that the results indicated fluid flow-off issues with the supercritical wing when using PG fluids at the lower temperatures. The results indicated that the changes to the guidance material made the previous winter were still relevant and should remain in the allowance time table for the winter of 2011-12. However, a large part of the 2010-11 work was focused on developing a correlation between the PIWT and the aerodynamic acceptance test. Based on the work that was conducted by NASA and APS, it was determined that a maximum lift loss of 5.24% on the B737-200ADV airplane is equivalent to a lift loss of 7.29% on the PIWT model. Due to the scatter in the data, the standard error of the estimate resulted in a range of values which determined an upper limit of lift loss on the PIWT model of 9.2% and a lower limit of 5.4%. Currently the scatter in the "review" range is still large and causes complications when analyzing the data collected. It is anticipated that as future testing progresses, and as more data is collected, a single-value pass/fail cutoff maybe developed similar to the AAT and B737-200ADV airplane tests.

Due to industry concern with the validity of the results obtained, and the relevance of the test methods to operational aircraft, it was recommended that testing during the winter of 2011-12 focus on surveying and calibrating the wind tunnel to obtain a better sense of the repeatability of the results. With the support of NRC and under direction of NASA, a large series of test runs were conducted to better understand the performance characteristics of the wind tunnel and airfoil. The results indicated that the year-to-year equipment and facility upgrades have increased the integrity of the aerodynamic data produced, and the wind tunnel can closely simulate aircraft take-off profiles. The characterization of the current dry wing model with original endplates demonstrated appropriate aerodynamic behavior. The back-to-back fluid-only runs demonstrated excellent repeatability of test methods and this was reflected in the aerodynamic data collected. The repeatability of the testing was considered acceptable for this type of aerodynamic testing work and was not indicative of systematic errors in procedures or equipment.

FAA and TC were satisfied with calibration technical evaluation results, and therefore it was recommended that testing during the winter of 2012-13 revert back to the initial research and development objectives of further refining and substantiating the ice pellet allowance times.

2. OBJECTIVES

Note, some limited follow-up testing to support the 2011-12 calibration and characterization work conducted will be performed by NASA and NRC prior to the start of the 2012-13 testing campaign. See Attachment I for further details.

The objective of this testing is to conduct aerodynamic testing with a super critical airfoil to:

- Ensure the repeatability of the dry wing performance;
- Expand the ice pellet allowance times for light ice pellets mixed with light or moderate snow conditions;
- Investigate of the higher lift losses observed at lower temperatures with PG fluids;
- Substantiate the current ice pellet allowance times with new fluids, or fluids previously tested but with limited data;
- Evaluate the effects of fluid viscosity on aerodynamic performance;
- Further develop the PIWT testing results correlation to the BLDT test;
- Evaluate the use of a stall warning sensor with and without de/anti-icing fluids;
- Evaluate the interaction of an ice phobic coated wing skin with fluid and contamination; and
- Evaluate the effect of ice phobic coatings on the fluid BLDT at low rotation speeds.

Also, plans are to have a ROGIDS installed in the wind tunnel to collect data of a contaminated wing.

Attachments II to IV provide additional information for performing some of these activities which may not use the typical wind tunnel testing methodology.

As lower priority objectives, testing may be conducted to investigate other objectives of high importance to industry which may include (and is described further in Section 6.11):

- Fluid and contamination at LOUT;
- Heavy snow;
- Heavy contamination;
- Small hail;
- Frost simulation in the wind tunnel;
- Wind tunnel test section cooling;
- Flaps/Slats testing to support YMX tests;
- Mixed HOT conditions;
- Frost spot deicing/anti-icing;

- Snow on an un-protected wing;
- Feasibility of IP testing at higher speed (130-150kts);
- Light and very light snow HOT's;
- Windshield washer used as a Type I deicer; and
- Effect of fluid seepage on dry wing performance.

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

Four weeks of testing have been scheduled for the conduct of these tests. The start date for testing is currently scheduled for January 8th and testing will continue until February 1st (see Figure 2.2).

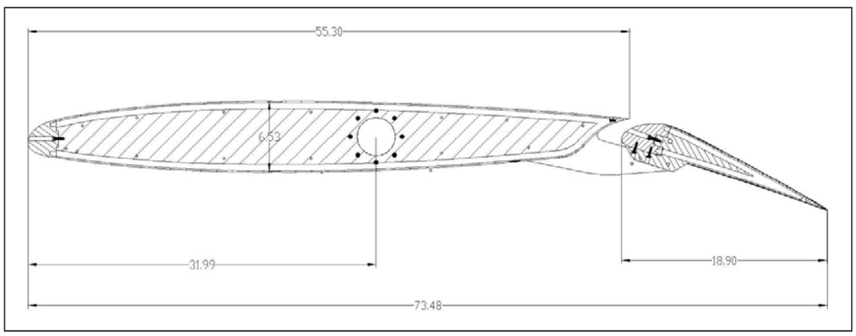


Figure 2.1: Super-Critical Wing Section

3. TEST PLAN

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

Representative Type I/III/IV propylene and ethylene fluids in Neat form (standard mix for Type I) shall be evaluated against their uncontaminated performance; Attachments V to XI present the generic holdover time guidelines for Type I and III as well as the fluid-specific holdover time guidelines for the representative Type IV fluids that will be tested. The current Ice Pellet Allowance Time table has been included in XII.

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

Wind Tunnel 2012-13
Anticipated Calender of Tests
JANUARY 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
NASA WT Calibration (DEC 19 & 20) TEST DAYS 1 & 2		1	2 NRC back from holidays	3	4	5
6	7 Pack Truck and leave for YOW	8 *TEST DAY 3* -Set-up, calibration, training, briefing **EVALUATION OF STALLWARNING SENSOR** *any temp* *Priority 1*	9 *TEST DAY 4* **IP VALIDATION (DAY 1 OF 3)** *-5 °C and above* *Priority 2*	10 *TEST DAY 5* **IP VALIDATION (DAY 2 OF 3)** *-5°C and above* *Priority 2*	11 *TEST DAY 6* **IP VALIDATION (DAY 3 OF 3)** *-5 to -10 °C* *Priority 2*	12
13	14 *TEST DAY 7* **IP FLOW-OFF (DAY 1 OF 3)** *below -10 °C* *Priority 1*	15 *TEST DAY 8* **IP FLOW-OFF (DAY 2 OF 3)** *below -10 °C* *Priority 1*	16 *TEST DAY 9* **IP FLOW-OFF (DAY 3 OF 3)** *below -10 °C* *Priority 1*	17 *TEST DAY 10* **EFFECT OF VISCOSITY ON AERODYNAMICS (DAY 1 OF 2)** *below -20°C* *Priority 2*	18 *TEST DAY 11* **EFFECT OF VISCOSITY ON AERODYNAMICS (DAY 2 OF 2)** *-20°C and above* *Priority 2*	19
20	21 *TEST DAY 12* **BLDT CORRELATION (DAY 1 OF 3)** *-15 to -22.5 °C* *Priority 2*	22 *TEST DAY 13* **BLDT CORRELATION (DAY 2 OF 3)** *-22.5 to -35 °C* *Priority 2*	23 *TEST DAY 14* **BLDT CORRELATION (DAY 3 OF 3)** *-22.5 to -35°C* *Priority 2*	24 *TEST DAY 15* **IP EXPANSION** ***IP-/SN & IP-/SN-*** **(DAY 1 OF 2)** *-15 to -25°C* *Priority 2*	25 *TEST DAY 16* **IP EXPANSION** ***IP-/SN & IP-/SN-*** **(DAY 2 OF 2)** *-5 to -10°C* *Priority 2*	26
27	28 *TEST DAY 17* **ICE PHOBIC BLDT** *-6 to -20 °C* *Priority 1*	29 *TEST DAY 18* **ICE PHOBIC R&D (DAY 1 OF 3)** *<-10 °C* *Priority 1*	30 *TEST DAY 19* **ICE PHOBIC R&D (DAY 2 OF 3)** *-5 to -15 °C* *Priority 1*	31 *TEST DAY 20* **ICE PHOBIC R&D (DAY 3 OF 3)** *<-5 °C* *Priority 1*	FEB 1 *TEST DAY 21* **DRY RUNS** **(dry runs every day accumulates over test period ~ 1 day)**	FEB 2
FEB 3	FEB 4 *SPARE*	FEB 5 *WEEK AVAILABLE*	FEB 6 *IF TEMPS ARE*	FEB 7 *NOT GOOD IN*	FEB 8 *JANUARY*	FEB 9

NOTES
Anticipate Mon-Fri Testing, However, Weekend May be Needed Due to Temperature.
First week of testing to be conducted during daytime and the following weeks will be overnights. This will be dependent on the weather forecast and required temperature needed for testing.
Testing will Likely be Conducted During Overnight Periods (i.e. 8PM - 6AM), Unless Temperatures are Suitable for Day, Evening Testing. Typical Test Day is 8hrs for APS Staff.
If 20th day required, consider 1-2 hours longer per day.

Figure 3.1: Test Calendar

A preliminary list of test objectives is shown in Table 3.1. It should be noted that the order in which the tests will be carried out will be depend on weather conditions and TC/FAA directive. A detailed preliminary test matrix is shown in Table 3.2.

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

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

A presentation was prepared to describe the test plan in further detail, see Appendix A.

Table 3.1: Preliminary List of Testing Objectives for Winter 2012-13 Wind Tunnel Testing

Focus of testing will primarily be on Priority 1 & 2
Some Priority 3 may be completed at request of the TC/FAA

Item #	Objective	Priority	Description	# of Days
1	Dry Wing Baseline Repeatability	1	Baseline test at beginning of each day. Ensure repeatability	1
2	IP Flow-Off Issues (IP - and IP Mod <-10ºC)	1	Collect data in problem area conditions where data showed flow-off issues. I.e. IP- and IP <-10ºC and diff fluids	3
3	ROGIDS Piggyback Testing in Wind Tunnel	1	Non-intrusive testing with PV Labs, so no extra days needed. Observe icing tests with different conditions i.e. Ice Pellets.	0
4	Ice Phobic Coating R&D	1	Aero research with ice phobic treated surfaces. Possibly construct different test models i.e. Skins or Streamline posts	3
5	Effect of Ice Phobic Coatings on BLDT	1	Aero research comparing fluid Δcl data with and without coatings at different temps	1
6	Evaluation of Stallwarning Sensor	1	Testing with Marinvent sensor to evaluate potential for use in ground icing operations with and without fluids	1
7	Effect of Viscosity on Fluid Aerodynamics	2.1	Evaluate effect of viscosity on aero flow-off to better understand year to year differences with same fluid (test high and low visc)	2
8	BLDT Correlation	2.2	Fluid only testing to further develop BLDT/Aero test correlation and to include different fluids	3
9	IP Expansion (IP-/SN and IP-/SN-)	2.3	Expand IP Allowance Time Table for IP-/SN and IP-/SN-	2
10	IP Validation with New Fluids	2.4	Spot check validation testing with new fluids or fluids that have limited data i.e. Cryotech?, AD-49? etc	3
11	Fluid + Cont @ LOUT	3	Effect of contamination on fluid performance at LOUT with IP, SN, ZF,Frost etc.	2
12	Heavy Snow	3	Continue Heavy Snow Research comparing lift losses with Light/Moderate Snow vs. heavy Snow	2
13	Aero vs. Visual Fail (Surface Roughness)	3	Continue work looking at aerodynamic failure vs. HOT defined failure, and effect of surface roughness on lift degradation	2
14	Small Hail	3	Develop HOT Guidance for small hail. Requires consult with meteorologist for specific conditions	1
15	Simulate Frost in Wind Tunnel	3	Attempt to simulate frost conditions in wind tunnel.	1
16	Tunnel Test Section Cooling System	3	Investigate methods for cooling wind tunnel	1
17	2nd Wave of Fluid During Rotation	3	Investigate the aero effects of the 2nd wave of fluid created from fluid at the stagnation point which flows over the LE during rotation	1
18	Other	3	Any potential suggestions from industry	1
19	Flaps/Slats to Support YMX	4	Conduct flaps failure research to support UPS/SWA trials, comparative fluid/cont. and possibly sandpaper tests	2
20	Mixed HOT Conditions	4	Develop HOT Guidance for mixed conditions i.e. ZR/SN, R/SN, ZD/SN	2
21	Aero WG Outstanding Items	4	Testing to address outstanding items from technical questions sent from Aero WG	3
22	Frost CSW Spot Deicing	4	Aerodynamic lift losses associated with CSW spot deicing. Look at thickened fluids. Aero vs FFP limited	1
23	Snow on Un-protected Wing	4	Continue previous research	1
24	130-150 Knots IP Testing	4	Conduct IP testing at 130-150 knots NEED TO MODIFY TUNNEL	5
25	IP Validation with Slatted Wing (e.g. CRJ 700, B737)	4	IP testing with new slatted wing model e.g. CRJ 700, B737 NEED TO BUILD WING TO DO TESTING	5
26	Horizontal Stabilizer Testing	4	Testing with undermounted camera to investigate fluid flow on underside of H-Stab section. NEED TO BUILD H-STAB	10
27	V-Stab	4	Effect of heavily contaminated tail (un-even contamination) NEED TO BUILD V-STAB	5
28	Ice Phobic Coatings on V-Stab	4	Potential benefits of coatings on V-Stab NEED V-STAB MODEL OR ALTERNATIVE	4
29	BLDT Testing with Old wings	4	BLDT correlation work with NACA 23012 and LS0417 wing sections	5
30	Type IV Low Speed	5	Continue LS Type IV IP Allowance Time Testing	5
31	Type III IP Allowance Times (HS)	5	Conduct High Speed IP Allowance time testing with Type III fluid (Hot and Cold) in all cells to potentially develop Type III table	5
32	Type II IP Testing	6	Develop Type II IP Allowance Times	5
33	Type III IP Allowance Times (LS)	6	Conduct Low Speed IP Allowance time testing with Type III fluid (Hot and Cold) in all cells to potentially develop Type III table	5

Table 3.1: Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P001	Baseline	1	1	Dry Wing	8	100	any	none		-	-	-		-	to be conducted daily before start ot tests
P002	Baseline	1	1	Dry Wing	stall	100	any	none		-	-	-		-	to be conducted daily before start ot tests
P003	IP Flow-Off Issues	1	1	IP-	8	100	< -10°C	ABC-S Plus	100/0	25	-	-		30	
P004	IP Flow-Off Issues	1	1	IP-	8	115	< -10°C	ABC-S Plus	100/0	25	-	-		30	
P005	IP Flow-Off Issues	1	1	IP-	8	100	< -10°C	Launch	100/0	25	-	-		30	
P006	IP Flow-Off Issues	1	1	IP-	8	115	< -10°C	Launch	100/0	25	-	-		30	
P007	IP Flow-Off Issues	1	1	IP-	8	100	< -10°C	AD-49	100/0	25	-	-		30	
P008	IP Flow-Off Issues	1	1	IP-	8	115	< -10°C	AD-49	100/0	25	-	-		30	
P009	IP Flow-Off Issues	1	1	IP-	8	100	< -10°C	Max-Flight	100/0	25	-	-		30	
P010	IP Flow-Off Issues	1	1	IP-	8	115	< -10°C	Max-Flight	100/0	25	-	-		30	
P011	IP Flow-Off Issues	1	1	IP-	8	100	< -10°C	Polar Guard Advance	100/0	25	-	-		30	
P012	IP Flow-Off Issues	1	1	IP-	8	115	< -10°C	Polar Guard Advance	100/0	25	-	-		30	
P013	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	ABC-S Plus	100/0	75	-	-		5	
P014	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	ABC-S Plus	100/0	75	-	-		5	
P015	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	Launch	100/0	75	-	-		5	
P016	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	Launch	100/0	75	-	-		5	
P017	IP Flow-Off Issues	1	2	IP mod	8	100	< -10°C	AD-49	100/0	75	-	-		5	
P018	IP Flow-Off Issues	1	2	IP mod	8	115	< -10°C	AD-49	100/0	75	-	-		5	
P019	IP Flow-Off Issues	1	2	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-		5	
P020	IP Flow-Off Issues	1	2	IP mod	8	115	< -10°C	Max-Flight	100/0	75	-	-		5	
P021	IP Flow-Off Issues	1	2	IP mod	8	100	< -10°C	Polar Guard Advance	100/0	75	-	-		5	
P022	IP Flow-Off Issues	1	2	IP mod	8	115	< -10°C	Polar Guard Advance	100/0	75	-	-		5	
P023	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	ABC-S Plus	100/0	75	-	-		10	
P024	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	ABC-S Plus	100/0	75	-	-		10	
P025	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	Launch	100/0	75	-	-		10	
P026	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	Launch	100/0	75	-	-		10	

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P027	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	AD-49	100/0	75	-	-		10	
P028	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	AD-49	100/0	75	-	-		10	
P029	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-		10	
P030	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	Max-Flight	100/0	75	-	-		10	
P031	IP Flow-Off Issues	1	1	IP mod	8	100	< -10°C	Polar Guard Advance	100/0	75	-	-		10	
P032	IP Flow-Off Issues	1	1	IP mod	8	115	< -10°C	Polar Guard Advance	100/0	75	-	-		10	
P033	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	CO	-	C0 Objective: Baseline
P034	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	C1	-	C1 Objective: Baseline
P035	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	C2	-	C2 Objective: Baseline
P036	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	C3	-	C3 Objective: Baseline
P037	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	C4	-	C4 Objective: Baseline
P038	Ice Phobic Coating R&D	2	1	None	8	100	< -10°C	none	-	-	-	-	C5	-	C5 (USE P001 OF THE DAY) Objective: Baseline
P039	Ice Phobic Coating R&D	2	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C0	10	C0 Objective: Flow-off
P040	Ice Phobic Coating R&D	2	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C1	10	C1 Objective: Flow-off
P041	Ice Phobic Coating R&D	2	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C2	10	C2 Objective: Flow-off
P042	Ice Phobic Coating R&D	2	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C3	10	C3 Objective: Flow-off
P043	Ice Phobic Coating R&D	2	1	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C4	10	C4 Objective: Flow-off
P044	Ice Phobic Coating R&D	2	2	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	C5	10	C5 Objective: Flow-off
P045	Ice Phobic Coating R&D	2	2	IP mod	8	100	< -10°C	Max-Flight	100/0	75	-	-	ANY	10	any of C1 or C2 or C3 or C4 Objective: effect of viscosity (use LOWV fluid)
P046	Ice Phobic Coating R&D	1	1	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C0	-	C0 Objective: adhesion
P047	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C0	20	C0 Objective: adhesion
P048	Ice Phobic Coating R&D	1	1	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C0	20	C0 Objective: adhesion
P049	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	none	-	-	-	25	C0	20	C0 Objective: adhesion
P050	Ice Phobic Coating R&D	1	1	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C1	-	C1 Objective: adhesion
P051	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C1	20	C1 Objective: adhesion
P052	Ice Phobic Coating R&D	1	1	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C1	20	C1 Objective: adhesion

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P053	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	none	-	-	-	25	C1	20	C1 Objective: adhesion
P054	Ice Phobic Coating R&D	1	1	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C2	-	C2 Objective: adhesion
P055	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C2	20	C2 Objective: adhesion
P056	Ice Phobic Coating R&D	1	1	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C2	20	C2 Objective: adhesion
P057	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	none	-	-	-	25	C2	20	C2 Objective: adhesion
P058	Ice Phobic Coating R&D	1	1	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C3	-	C3 Objective: adhesion
P059	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C3	20	C3 Objective: adhesion
P060	Ice Phobic Coating R&D	1	1	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C3	20	C3 Objective: adhesion
P061	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	none	-	-	-	25	C3	20	C3 Objective: adhesion
P062	Ice Phobic Coating R&D	1	1	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C4	-	C4 Objective: adhesion
P063	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C4	20	C4 Objective: adhesion
P064	Ice Phobic Coating R&D	1	1	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C4	20	C4 Objective: adhesion
P065	Ice Phobic Coating R&D	1	1	ZR	8	100	-5 to -15	none	-	-	-	25	C4	20	C4 Objective: adhesion
P066	Ice Phobic Coating R&D	1	2	Fluid only	8	100	-5 to -15	EG106	100/0	-	-	-	C5	-	C5 Objective: adhesion
P067	Ice Phobic Coating R&D	1	2	ZR	8	100	-5 to -15	EG106	100/0	-	-	25	C5	20	C5 Objective: adhesion
P068	Ice Phobic Coating R&D	1	2	IP- / ZR	8	100	-5 to -15	EG106	100/0	25	-	25	C5	20	C5Objective: adhesion
P069	Ice Phobic Coating R&D	1	2	ZR	8	100	-5 to -15	none	-	-	-	25	C5	20	C5 Objective: adhesion
P070	Ice Phobic Coating R&D	1	2	IP- / ZR	8	115	-5 to -15	EG106	100/0	25	-	25	ANY	20	any of C1 or C2 or C3 or C4 Objective: adhesion
P071	Ice Phobic Coating R&D	1	2	IP- / ZR	8	115	-5 to -15	EG106	100/0	25	-	25	ANY	20	any of C1 or C2 or C3 or C4 Objective: adhesion
P072	Ice Phobic Coating R&D	1	2	IP- / ZR	8	80	-5 to -15	EG106	100/0	25	-	25	ANY	20	any of C1 or C2 or C3 or C4 Objective: adhesion
P073	Ice Phobic Coating R&D	1	2	IP- / ZR	8	80	-5 to -15	EG106	100/0	25	-	25	ANY	20	any of C1 or C2 or C3 or C4 Objective: adhesion
P074	Ice Phobic Coating R&D	1	2	SN	8	100	-5 to -15	none	-	-	TBD	-	ANY	TBD	any of C1 or C2 or C3 or C4 Objective: adhesion
P075	Ice Phobic Coating R&D	1	2	SN	8	115	-5 to -15	none	-	-	TBD	-	SAME AS P072	TBD	same surface as P072 Objective: adhesion
P076	Ice Phobic Coating R&D	1	1	Fluid Only	8	100	< -5	EG106	100/0	-	-	-	C1/C5	-	C1 & C5 Objective: visual comparison
P077	Ice Phobic Coating R&D	1	1	ZR	8	100	< -5	EG106	100/0	-	-	50	C1/C5	115?? (as per 2010-11)	C1 & C5 Objective: visual comparison

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P078	Ice Phobic Coating R&D	1	1	Fluid Only	8	100	< -5	EG106	100/0	-	-	-	C0/C5	-	C0 & C5 Objective: visual comparison
P079	Ice Phobic Coating R&D	1	1	ZR	8	100	< -5	EG106	100/0	-	-	50	C0/C5	115? (as 2010-11)	C0 & C5 Objective: visual comparison
P080	Ice Phobic Coating R&D	1	1	Fluid Only	8	100	< -5	EG106	100/0	-	-	-	C1/C2	-	C1 & C2 Objective: visual comparison
P081	Ice Phobic Coating R&D	1	1	ZR	8	100	< -5	EG106	100/0	-	-	50	C1/C2	115? (as 2010-11)	C1 & C2 Objective: visual comparison
P082	Ice Phobic Coating R&D	1	1	Fluid Only	8	100	< -5	EG106	100/0	-	-	-	C3/C4	-	C3 & C4 Objective: visual comparison
P083	Ice Phobic Coating R&D	1	1	ZR	8	100	< -5	EG106	100/0	-	-	50	C3/C4	115? (as 2010-11)	C3 & C4 Objective: visual comparison
P084	Ice Phobic Coating R&D	1	2	Fluid Only	8	100	< -5	EG106	100/0	-	-	-	C0/ANY	-	C0 & one of C1, C2, C3 or C4 Objective: visual comparison
P085	Ice Phobic Coating R&D	1	2	ZR	8	100	< -5	EG106	100/0	-	-	50	C0/ANY	115? (as 2010-11)	C0 & one of C1, C2, C3 or C4 Objective: visual comparison
P086	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C0	-	C0
P087	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C1	-	C1
P088	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C2	-	C2
P089	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C3	-	C3
P090	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C4	-	C4
P091	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	below -16.5 +/- 3	MP III 2031	100/0	-	-	-	C5	-	C5
P092	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	-9 +/- 3	MP III 2031	75/25	-	-	-	C0	-	C0
P093	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	-9 +/- 3	MP III 2031	75/25	-	-	-	C5	-	C5
P094	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	LS (67?)	-9 +/- 3	MP III 2031	75/25	-	-	-	ANY	-	Pick one of C1, C2, C3 or C4
P095	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C0	-	C0
P096	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C1	-	C1
P097	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C2	-	C2
P098	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C3	-	C3
P099	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C4	-	C4
P100	Effect of Ice Phobic Coatings on BLDT	1	1	Fluid Only	8	100	-26 +/- 3	AD-49	100/0	-	-	-	C5	-	C5
P101	Evaluation of Stallwarning Sensor	1	1	none	stall	100	any	none	-	-	-	-		-	NO SENSOR ensure sensor is non intrusive
P102	Evaluation of Stallwarning Sensor	1	2	none	stall	100	any	none	-	-	-	-		-	NO SENSOR (REPEAT) ensure sensor is non intrusive
P103	Evaluation of Stallwarning Sensor	1	1	none	stall	100	any	none	-	-	-	-		-	WITH SENSOR ensure sensor is non intrusive

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	Coating	Exposure Time	COMMENT
P104	Evaluation of Stallwarning Sensor	1	2	none	stall	100	any	none	-	-	-	-		-	WITH SENSOR (REPEAT) ensure sensor is non intrusive
P105	Evaluation of Stallwarning Sensor	1	1	Fluid Only	stall	100	any	EG106	100/0	-	-	-		-	NO SENSOR ensure sensor is non intrusive
P106	Evaluation of Stallwarning Sensor	1	2	Fluid Only	stall	100	any	EG106	100/0	-	-	-		-	NO SENSOR (REPEAT) ensure sensor is non intrusive
P107	Evaluation of Stallwarning Sensor	1	1	Fluid Only	stall	100	any	EG106	100/0	-	-	-		-	WITH SENSOR ensure sensor is non intrusive
P108	Evaluation of Stallwarning Sensor	1	2	Fluid Only	stall	100	any	EG106	100/0	-	-	-		-	WITH SENSOR (REPEAT) ensure sensor is non intrusive
P109	Evaluation of Stallwarning Sensor	1	1	Fluid Only	stall	100	any	EG106	100/0	75	-	-		15-35	WITH SENSOR ensure sensor is working
P110	Evaluation of Stallwarning Sensor	1	1	Fluid Only	stall	100	any	Type I EG	100/0	-	-	-		-	WITH SENSOR ensure sensor is working
P111	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	ABC-S Plus	100/0	-	-	-		-	
P112	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	ABC-S Plus	100/0	-	-	-		-	
P113	BLDT Correlation	2.1	2	Fluid only	8	100	-22.5 to -35	ABC-S Plus	100/0	-	-	-		-	
P114	BLDT Correlation	2.1	1	Fluid only	8	100	-15 to -22.5	ABC-S Plus	75/25	-	-	-		-	
P115	BLDT Correlation	2.1	2	Fluid only	8	100	-15 to -22.5	ABC-S Plus	75/25	-	-	-		-	
P116	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	EG106	100/0	-	-	-		-	
P117	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	EG106	100/0	-	-	-		-	
P118	BLDT Correlation	2.1	2	Fluid only	8	100	-22.5 to -35	EG106	100/0	-	-	-		-	
P119	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	Launch	100/0	-	-	-		-	
P120	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	Launch	100/0	-	-	-		-	
P121	BLDT Correlation	2.1	2	Fluid only	8	100	-22.5 to -35	Launch	100/0	-	-	-		-	
P122	BLDT Correlation	2.1	1	Fluid only	8	100	-15 to -22.5	Launch	75/25	-	-	-		-	
P123	BLDT Correlation	2.1	2	Fluid only	8	100	-15 to -22.5	Launch	75/25	-	-	-		-	
P124	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	AD-49	100/0	-	-	-		-	
P125	BLDT Correlation	2.1	1	Fluid only	8	100	-22.5 to -35	AD-49	100/0	-	-	-		-	
P126	BLDT Correlation	2.1	2	Fluid only	8	100	-22.5 to -35	AD-49	100/0	-	-	-		-	
P127	BLDT Correlation	2.1	1	Fluid only	8	100	-15 to -22.5	AD-49	75/25	-	-	-		-	
P128	BLDT Correlation	2.1	2	Fluid Only	8	100	-15 to -22.5	AD-49	75/25	-	-	-		-	
P129	BLDT Correlation	2.1	1	Fluid Only	8	100	-22.5 to -35	Polar Guard Advance	100/0	-	-	-		-	

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P130	BLDT Correlation	2.1	1	Fluid Only	8	100	-22.5 to -35	Polar Guard Advance	100/0	-	-	-		-	
P131	BLDT Correlation	2.1	2	Fluid Only	8	100	-22.5 to -35	Polar Guard Advance	100/0	-	-	-		-	
P132	BLDT Correlation	2.1	1	Fluid Only	8	100	-15 to -22.5	Polar Guard Advance	75/25	-	-	-		-	
P133	BLDT Correlation	2.1	2	Fluid Only	8	100	-15 to -22.5	Polar Guard Advance	75/25	-	-	-		-	
P134	BLDT Correlation	2.1	1	Fluid Only	8	100	-22.5 to -35	Max-Flight	100/0	-	-	-		-	
P135	BLDT Correlation	2.1	1	Fluid Only	8	100	-22.5 to -35	Max-Flight	100/0	-	-	-		-	
P136	BLDT Correlation	2.1	2	Fluid Only	8	100	-22.5 to -35	Max-Flight	100/0	-	-	-		-	
P137	BLDT Correlation	2.1	1	Fluid Only	8	100	-15 to -22.5	Max-Flight	75/25	-	-	-		-	
P138	BLDT Correlation	2.1	2	Fluid Only	8	100	-15 to -22.5	Max-Flight	75/25	-	-	-		-	
P139	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	-20 and above	ABC-S Plus	100/0	-	-	-		-	low viscosity
P140	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	-20 and above	ABC-S Plus	100/0	-	-	-		-	mid viscosity
P141	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	-20 and above	Launch	100/0	-	-	-		-	low viscosity
P142	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	-20 and above	Launch	100/0	-	-	-		-	mid viscosity
P143	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	-20 and above	AD-49	100/0	-	-	-		-	low viscosity
P144	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	-20 and above	AD-49	100/0	-	-	-		-	mid viscosity
P145	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	-20 and above	Polar Guard Advance	100/0	-	-	-		-	low viscosity
P146	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	-20 and above	Polar Guard Advance	100/0	-	-	-		-	mid viscosity
P147	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	below -20	ABC-S Plus	100/0	-	-	-		-	low viscosity
P148	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	below -20	ABC-S Plus	100/0	-	-	-		-	mid viscosity
P149	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	below -20	Launch	100/0	-	-	-		-	low viscosity
P150	Effect of Viscosity on Fluid Aerodynamics	2.2	1	Fluid only	8	100	below -20	Launch	100/0	-	-	-		-	mid viscosity
P151	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	below -20	AD-49	100/0	-	-	-		-	low viscosity
P152	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	below -20	AD-49	100/0	-	-	-		-	mid viscosity
P153	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	below -20	Polar Guard Advance	100/0	-	-	-		-	low viscosity
P154	Effect of Viscosity on Fluid Aerodynamics	2.2	2	Fluid only	8	100	below -20	Polar Guard Advance	100/0	-	-	-		-	mid viscosity
P155	IP Expansion	2.3	1	IP- / SN-	8	100	-10	EG106	100/0	25	10	10		5-10	

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate ($g/dm^2/h$)	SN Rate ($g/dm^2/h$)	ZR Rate ($g/dm^2/h$)	Coating	Exposure Time	COMMENT
P156	IP Expansion	2.3	1	IP- / SN-	8	100	-10	ABC-S Plus	100/0	25	10	10		5	
P157	IP Expansion	2.3	1	IP- / SN-	8	100	-10	Launch	100/0	25	10	10		5	
P158	IP Expansion	2.3	1	IP- / SN-	8	100	-10	Max-Flight	100/0	25	10	10		5	
P159	IP Expansion	2.3	1	IP- / SN-	8	100	-10	AD-49	100/0	25	10	10		5	
P160	IP Expansion	2.3	1	IP- / SN-	8	100	-10	Polar Guard Advance	100/0	25	10	10		5	
P161	IP Expansion	2.3	2	IP- / SN-	8	100	-15	EG106	100/0	25	10	10		5-10	
P162	IP Expansion	2.3	2	IP- / SN-	8	100	-15	ABC-S Plus	100/0	25	10	10		5	
P163	IP Expansion	2.3	2	IP- / SN-	8	100	-15	Launch	100/0	25	10	10		5	
P164	IP Expansion	2.3	2	IP- / SN-	8	100	-15	Max-Flight	100/0	25	10	10		5	
P165	IP Expansion	2.3	2	IP- / SN-	8	100	-15	AD-49	100/0	25	10	10		5	
P166	IP Expansion	2.3	2	IP- / SN-	8	100	-15	Polar Guard Advance	100/0	25	10	10		5	
P167	IP Expansion	2.3	2	IP- / SN-	8	100	-25	EG106	100/0	25	10	10		5-10	
P168	IP Expansion	2.3	2	IP- / SN-	8	100	-25	ABC-S Plus	100/0	25	10	10		5	
P169	IP Expansion	2.3	2	IP- / SN-	8	100	-25	Launch	100/0	25	10	10		5	
P170	IP Expansion	2.3	2	IP- / SN-	8	100	-25	Max-Flight	100/0	25	10	10		5	
P171	IP Expansion	2.3	2	IP- / SN-	8	100	-25	AD-49	100/0	25	10	10		5	
P172	IP Expansion	2.3	2	IP- / SN-	8	100	-25	Polar Guard Advance	100/0	25	10	10		5	
P173	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	EG106	100/0	25	25	25		5-10	
P174	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	ABC-S Plus	100/0	25	25	25		5	
P175	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	Launch	100/0	25	25	25		5	
P176	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	Max-Flight	100/0	25	25	25		5	
P177	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	AD-49	100/0	25	25	25		5	
P178	IP Expansion	2.3	2	IP- / SN	8	100	-5 to -10	Polar Guard Advance	100/0	25	25	25		5	
P179	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 and above	Max-Flight	100/0	25	-	-		50	
P180	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 and above	AD-49	100/0	25	-	-		50	
P181	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 and above	Polar Guard Advance	100/0	25	-	-		50	

Table 3.1 (cont'd): Proposed Test Plan

Test Plan #	Objective	Objective Priority	Priority	Test Condition	Rotation Angle	Ramp (s/kts)	Target OAT (°C)	Fluid	Dilution	IP Rate (g/dm²/h)	SN Rate (g/dm²/h)	ZR Rate (g/dm²/h)	Coating	Exposure Time	COMMENT
P182	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 and above	Max-Flight	100/0	75	-	-		25	
P183	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 and above	AD-49	100/0	75	-	-		25	
P184	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 and above	Polar Guard Advance	100/0	75	-	-		25	
P185	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 to -10	Max-Flight	100/0	25	-	-		30	
P186	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 to -10	AD-49	100/0	25	-	-		30	
P187	IP Validation with New Fluids	2.4	2.4	IP-	8	100	-5 to -10	Polar Guard Advance	100/0	25	-	-		30	
P188	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 to -10	Max-Flight	100/0	75	-	-		10	
P189	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 to -10	AD-49	100/0	75	-	-		10	
P190	IP Validation with New Fluids	2.4	2.4	IP mod	8	100	-5 to -10	Polar Guard Advance	100/0	75	-	-		10	
P191	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 and above	Max-Flight	100/0	25	-	25		25	
P192	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 and above	AD-49	100/0	25	-	25		25	
P193	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 and above	Polar Guard Advance	100/0	25	-	25		25	
P194	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 to -10	Max-Flight	100/0	25	-	25		10	
P195	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 to -10	AD-49	100/0	25	-	25		10	
P196	IP Validation with New Fluids	2.4	2.4	IP- / ZR-	8	100	-5 to -10	Polar Guard Advance	100/0	25	-	25		10	
P197	IP Validation with New Fluids	2.4	2.4	IP- / ZR Mod	8	100	-5 and above	Max-Flight	100/0	25	-	75		25	
P198	IP Validation with New Fluids	2.4	2.4	IP- / ZR Mod	8	100	-5 and above	AD-49	100/0	25	-	75		25	
P199	IP Validation with New Fluids	2.4	2.4	IP- / ZR Mod	8	100	-5 and above	Polar Guard Advance	100/0	25	-	75		25	

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 XIII.

5. DATA FORMS

The following data forms are required for the January – February 2013 wind tunnel tests:

- Attachment XIV - General Form/Calibration;
- Attachment XV – General Form;
- Attachment XVI – Wing Temperature, Fluid Thickness and Fluid Brix Measurements and Condition of Wing and Plate Form;
- Attachment XVII, XVIII and XIX – Ice Pellet, Snow and Sifted Snow Dispensing Forms;
- Attachment XX – Visual Evaluation Rating Form
- Attachment XXI – Fluid Receipt Form (Generic form used by APS; will be used for this project as appropriate);
- Attachment XXII – Log of Fluid Sample Bottles.

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

6. PROCEDURE

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

6.1 Initial Test Conditions Survey

- Record ambient conditions of the test (Attachment XIV/XV); and
- Record wing temperature (Attachment XVI).

6.2 Fluid Application (Pour)

- Hand pour 20L of anti-icing fluid over the test area (fluid can be poured directly out of pales or transferred into smaller 3L jugs);
- Record fluid application times (Attachment XV);
- Record fluid application quantities (Attachment XV);
- 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 XVI);
- Record wing temperature (Attachment XVI).
- Measure fluid Brix value (Attachment XVI); and
- Photograph and videotape the appearance of the fluid on the wing;
- 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 in order to run a simultaneous endurance time test.

6.3 Application of Contamination

6.3.1 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:

1. Ice Pellets, Low Winds (0 to 5 km/h);
2. Ice Pellets, Moderate Winds (10 km/h);
3. Snow, Low Wind (0 to 5 km/h); and
4. 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.

6.3.2 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. Attachments XVII and XVIII 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% and a form to be used for this dispensing process along with dispensing instructions is included in Attachment XIX.

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

6.4 Prior to Engines-On Wind Tunnel Test

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

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 as been given to reducing the number of measures 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 behavior 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 XX); 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 XVI);
- Measure fluid Brix value (Attachment XVI);
- Record wing temperatures (Attachment XVI);
- Observe and record the status of the fluid/contamination (Attachment XX);
- Fill out visual evaluation rating form (Attachment XVI);
- 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 on the first day of testing. The fluid receipt form (Attachment XXI) should be completed indicating quantity of fluid and date received. Any samples extracted for viscosity purposes should be documented in the log of fluid samples data form (Attachment XXII). A falling ball viscosity test should be performed on site to confirm that fluid viscosity is appropriate 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, the glycol recovery service provider will be employed 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 2011-12. Modifications may be necessary to account for the different airfoil. 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 6.1 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

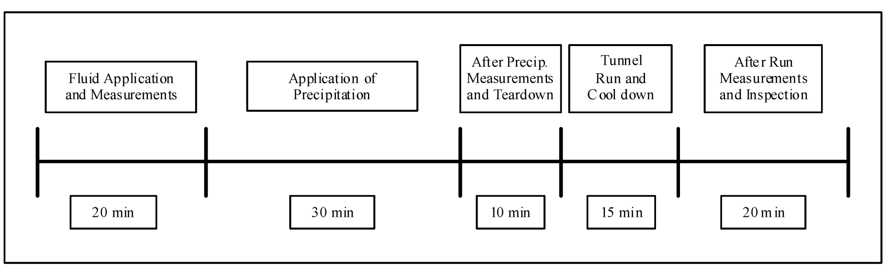


Figure 6.1: Typical Wind Tunnel Run Timeline

6.11 Procedures for R&D Activities

It is anticipated that testing will be conducted to support several research and development (R&D) activities. The objectives of these lower priority activities are as follows:

- Fluid and contamination at LOUT;
- Heavy snow;
- Heavy contamination;
- Small hail;
- Frost simulation in the wind tunnel;
- Wind tunnel test section cooling;
- Flaps/Slats testing to support YMX tests;
- Mixed HOT conditions;
- Frost spot deicing/anti-icing;
- Snow on an un-protected wing;
- Feasibility of IP testing at higher speed (130-150kts);
- Light and very light snow HOT's;
- Windshield washer used as a Type I deicer;
- Effect of fluid seepage on dry wing performance; and
- 2nd wave of fluid during rotation.

As these full-scale R&D activities have in general not been previously attempted, therefore brief summaries of the anticipated procedures have been prepared to provide guidance at the time of testing. These procedures are attached to this document as Attachments XXIII to XXXVII. The procedures are preliminary and may change based on the quality of the results obtained in the wind tunnel.

7. EQUIPMENT

Equipment to be employed is shown in Table 7.1.

Table 7.1: Test Equipment Checklist

EQUIPMENT	*STATUS*	*EQUIPMENT*	*STATUS*
General Support Equipment		***Camera Equipment***	
Large and small tape measure		Digital still cameras x3 (two suitcases)	
Fluids (ORDER and SHIP to Ottawa)		Flashes and tripods (in APS storage)	
Horse and tap for fluid barrel x 2		GoPro Camera	
Funnels		Older Xti (x3) cameras (as back-up for first week)	
Sample bottles for viscosity measurement x10		Obsolete Cameras (to be given to TC)	
Squeegees			
Isopropyl x24		***Ice Pellets Fabrication Equipment***	
Gloves, paper towel (lots)		Refrigerated Truck	
Extension cords		Ice pellets Styrofoam containers x20	
Clipboards, pencils, wing markers for sample locations and solvent		Ice bags	
Large Clock x1		Ice bags storage freezer	
Walkie Talkies x8		Blenders x6+	
Envelopes and labels		Ice pellets sieves	
Previous F20/WT reports (Elecronic Copies)		Folding tables	
Grid Section + Location docs		Measuring cups (1L and smaller ones for dispensing)	
Large Sharpies for Grid Section		Wooden Spoons	
Projector for laptop		Rubber Mats	
YOW employee contracts		NCAR Scale x1	
Blow Horns x4			
Stop Watches x4		***Freezing Rain Equipment***	
Calculators x3		NRC Freezing rain sprayer (not required)	
Scissors		APS PC equipped with rate station software	
Exacto Knives x2		White plastic rate pans (1 to 8 x 2) if necessary	
APS Laptops x5		Wooden boards for rate pans (x8)	
Dry eraser markers		Rubber suction cup feet for wooden boards	
		Sartorius Weigh Scale x1	
Test Equipment		Black Shelving Unit (or plastic)	
Test Procedures, data forms, printer paper			
Electronic copy of the whole wind tunnel procedure folder, incl all forms and working docs (maybe Falcon too).			
Hard Drive (3 x New) 2-APS 1-WU 0-TC??			
Test Plate			
Speed tape (large and small)			
Thickness Gauges			
Temperature Probe x 2 and spare batteries			
Brixometers X4			
Adherence Probes (Oral B) x4 with tips and charger			
Fluid pouring jugs x40?? (10 per fluid + extra)			
Ice pellets dispersers x6			
Stands for ice pellets dispensing devices x6			
Ice Pellet control wires and boxes (all)			
Ice pellet box supports for railing x4			
Hot Plate x3 and Large Pots with rubber handles			
Watmans Paper and conversion charts			
Long Ruler for marking wing x2			
Small 90º aluminum ruler for wing			
20L containers x12 (DY order from YUL)			
hard water chemicals			
Thermometer for Reefer Truck			
Poster board (8"x3") for flap section			

8. FLUIDS

Mid-viscosity samples of ethylene glycol and propylene glycol 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 (quantities to be confirmed once fluid is received). 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 Manufacturer	Fluid Name	Type	Viscosity	2012-13 Quantity Ordered (L)
ABAX	Ecowing AD-49	IV	Mid	700
			Low	60
Clariant Produkte	Launch	IV	Mid	400
			Low	60
	Max-Flight 04	IV	Mid	700
			Low	60
	MP III 2031 ECO	III	Mid	200
Cryotech	Polar Guard Advance	IV	Mid	600
			Low	60
Dow Chemical Company	EG106	IV	Mid	800
Kilfrost Limited	ABC-S PLUS	IV	Mid	500
			Low	60
			Total	4200

3600 L Ordered For 2009-10 Testing (18 Days)

3200 L Ordered For 2010-11 Testing (15 Days)

1800 L to be Ordered For 2011-12 Testing (7 of 15 days will be fluid testing)

9. PERSONNEL

Four APS staff members are required for the tests at the NRC wind tunnel. Four additional persons (with one back-up) 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

Wind Tunnel 11-12- Tentative	
Person	**Responsibility**
John	Overall Co-ordinator
Marco	Co-ordinator / General
Victoria	Forms & Data Collection Manager / IP Manager / YOW Pers. Manager / Camera Documentation
Dave	Data Collection / IP Support / Fluid Application / Fluid Manager
YOW Personnel	
Ben/Jesse	Photography
James	Fluids / IP / Dispensing / General Support
YOW 1	Fluids / IP / Dispensing
YOW 2	Fluids / IP / Dispensing
YOW 3	Fluids / IP / Dispensing
YOW 4	Back-up

NRC Institute of Aerospace Research Contacts

- Lucio Del Ciotto: (613) 913-9720
- Catherine Clark: (613) 998-6932

10. SAFETY

- A safety briefing will be done on the first day of testing;
- Personnel should be familiar with NRC emergency procedures i.e. DO NOT CALL 9-1-1, instead call the NRC Emergency Center as they will contact and direct the necessary services;

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

ATTACHMENT I - AERODYNAMIC CHARACTERIZATION OF THIN, HIGH-PERFORMANCE WING IN THE NRC PIWT TEST PLAN AND RATIONALE FOR WINTER 2013 CAMPAIGN

Limited Follow-on Testing
FAA/TC/APS/NRC/NASA Test Team

3 October 2012

Background and Overall Goal
Resulting from the discussions at the AWG meeting in Prague (May 2012), there were a few open questions regarding the aerodynamic characterization of the thin, high performance wing in the PIWT. These questions focused on the aerodynamics of the flap and how this contributes to the performance effects from the fluids/contamination. It is necessary to better understand these details in order to show that the fluids/contamination effects are not unique to this model, or to lessen the extent that they may be unique to this model. This understanding is necessary for the broad application for which the ice-pellet tests are intended.

1. Baseline (clean model) Repeatability

Objective and Rationale: verify that clean model aerodynamic data agree with the data acquired last year. Given the various issues with repeatability and angle of attack offsets in the past, this is an important step prior to fluids testing. Note that we should have the boundary-layer rake handy and ready to use if needed. This has the advantage of being the only independent measurement and could be used to sort out any discrepancies in the repeatability. Although very large discrepancies are considered highly unlikely, it would be good to have the necessary supplies to repeat the surface-oil flow visualization (self-adhesive film covering, mineral oil, black dye, paint roller, etc.).

1.1 Perform standard speed ramp profile and rotation to α = 8 deg. and hold. V = 100 kts. Compare C_L, C_M and C_D versus α results to data from previous test campaigns.

1.2 Perform standard speed ramp profile and rotation to α = 8 deg., and hold. V = 80 kts. Compare C_L, C_M and C_D to data from 1.1.

1.3 Perform standard speed ramp profile and rotation through stall. V = 80 kts. Compare C_L, C_M and C_D to data from 1.1, 1.2 and 1.3.

1.4 Set V = 80 kts and measure performance data from α = -4 deg. to α_{stall}+4 deg. in one degree increments (pitch & pause mode), then take data for decreasing angle of attack also at one degree increments. Compare C_L, C_M and C_D versus α results to data from previous test campaign (January 2012).

1.5 If there are any discrepancies in the repeatability consider installing the boundary layer rake to repeat previous measurements. Plotting the displacement and/or momentum thickness vs. angle of attack could provide useful information to sort out any discrepancies.

1.6 Perform repeat runs of 1.1 – 1.4 as time allows during the remainder of the test campaign.

2. Surface Roughness Tests

Objective and Rationale: to determine the influence of contamination on the flap and leading edge on wing performance. Data are needed to supplement the results of the January 2012 tests. These tests are designed to determine the performance sensitivity of the flap and leading edge to fluid/contamination. Note that use of the boundary-layer rake is requested for these tests.

2.1 Apply 80-grit sandpaper on the flap and acquire performance data through stall according to 1.1-1.4. Compare C_L, C_M and C_D versus α results to data from previous test campaign (January 2012) to make sure that there are no discrepancies.

2.2 Apply various sizes of roughness and simulated fluid on flap (e.g., use 150 and 40-grit sandpaper and a "smooth paper" thickness TBD) and acquire performance data through stall according to 1.1-1.4. For each of these cases, install the boundary-layer rake at two locations: midspan trailing edge of main element and midspan trailing edge of flap to measure status of boundary layer with simulated fluid on the flap.

2.3 Experiment with simulated fluid on the model leading edge. Simulated fluid to consist of smooth layer of tape or other covering. Thickness and width (streamwise distance) to be determined in consultation with the research team. Several locations should be tested acquiring performance data through stall according to 1.1-1.4.

2.4 Based upon the results from 2.1 to 2.3 select a few combinations of the simulated leading edge fluid and flap contamination and acquire performance data through stall according to 1.1-1.4.

ATTACHMENT II – Procedure: Ice Phobic Testing

Background

Ice build-up on aircraft is a major safety concern for both on-ground and in-flight aircraft operations. In recent years, there has been significant industry interest in the use of coatings to protect aircraft critical surfaces. Some recent work has studied these coatings (sometimes designed and marketed as ice phobic coatings) during in-flight operations, but the behavior and performance of these coatings during ground icing operations has yet to be fully investigated.

Previous preliminary work has been conducted during the winters of 2009-10 and 2010-11 and the results are described in the TC report TP 15055E, *Emerging De/Anti-Icing Technology: Evaluation of Ice Phobic Products for Potential Use in Aircraft Operation* (1) and in the TC report TP 15158E, *Aircraft Ground Icing Research General Activities During the 2010-11 Winter (2)*.

A broader test plan was developed and conducted during the winter of 2011-12 to investigate some additional areas of research not previously studied to gain some new insight into the potential applications of these coatings for aircraft operations, and to continue the research to include newly developed coating formulations. The results are described in the Interim TC report, *Investigation of Ice Phobic Technologies to Reduce Aircraft Icing in Northern and Cold Climates.* It was recommended that testing continue to investigate the effects of these coatings on de/anti-icing fluids from a HOT and aerodynamic perspective.

Objective

To investigate the aerodynamic performance of ice phobic coatings with and without de/anti-icing fluids.

Methodology

Testing will be conducted using wing skins specifically manufactured to fit onto the existing thin high performance wing section and be secured by bolts. To cover the entire test wing, two individual wing skin halves are required. Testing may be conducted by mix-matching two halves in order to obtain comparative data.

The general methodology to be used during these tests is in accordance with the methodologies used for typical fluid and contamination tests conducted in the wind tunnel:

- For each specific coating, conduct a fluid test simulating ice pellets and/or freezing rain, for an exposure time derived from the HOT table or allowance time table;

- Record lift data, visual observations, and manually collected data;
- Compare the aerodynamic performance to the baseline un-coated wing skin tests as well as to other coatings;
- In some cases, 2 different wing skin halves may be installed to provide a visual comparison of the fluid flow-off results. In such cases, the aerodynamic data collected should be dismissed;

Note: Consideration should be given to the time required to switch-over the wing skins as this will have significant impacts on scheduling.

Test Plan

Four days of testing are planned, however testing maybe reduced based on the results obtained at the discretion of the TC officer.

ATTACHMENT III – Procedure: Stall Warning Sensor

Background

Some current aircraft stall warning systems and ice detection systems may not account for contamination on the wing, give information during the take off roll, be effective at detecting high-speed stalls, be effective at measuring a tail stall, predict aerodynamic effect of contamination, or determine the extent of icing. Most importantly, some current stall warning systems may not be effective at preventing accidents involving icing.

Airfoil performance monitors (APM) are being developed and can be installed on any airfoil on an aircraft, including the tail. APM is designed to measure the airflow over the wing, which reveals how well the wing is working. As a wing becomes contaminated, the APM should measure the changing airflow and lift generated by the wing. The APM is designed to alert the crew if the airflow degrades below a configurable threshold, giving the crew time to correct a potential stall before it happens. It was recommended that testing be conducted with a Canadian developed APM to evaluate potential for use in ground icing operations with and without icing.

Objective

To evaluate the ability of the stall warning APM sensor to properly identify stall with and without icing conditions.

Methodology

- Conduct dry wing baseline testing with and without the installation to understand any potential aerodynamic influences the sensor may have;
- With the sensor installed conduct dry wing tests to stall.
- Repeat tests with fluid only to stall;
- Repeat tests with fluid and contamination to stall;
- Compare the APM measured stall to the stall observed through the aerodynamic data collected;

Test Plan

Six tests are anticipated for a total of one day of testing.

ATTACHMENT IV – Procedure: ROGIDS

Background

Remote on-ground ice detection systems (ROGIDS) have been in development for the aircraft ground icing industry for many years. A significant amount of research has been conducted with these systems to assess their performance, with varying results over the years. In 2004-05 research demonstrated that in certain circumstances ROGIDS are more reliable than human visual and/or tactile check in detecting clear ice on aircraft critical surfaces. An SAE working group was subsequently formed, and a standard for post-deicing was published by SAE in September 2007 followed by TC and FAA Advisory Circulars in the years following. Discussions in the working group about other potential applications for ROGIDS determined the next focus should be at the departure end of the runway. A flight crew survey completed in 2011-12 illustrated that locating a ROGIDS at the departure end of the runway could have a significant positive impact on safety. As a result, it was recommended that resources be allocated to advance the use of ROGIDS technology for the end-of-runway application

Objective

To support the development of ROGIDS technology by conducting post-deicing and end-of-runway testing.

Methodology

Arrangements have been made between FAA/TC and the ROGIDS manufacturers to have the systems installed in the wind tunnel during the winter 2012-13 testing. It is anticipated that the ROGIDS system will piggy-back on the current testing plans and will be non-intrusive. The ROGIDS operator will be able to collect video/photo data of a clean and contaminated wing.

Test Plan

This will be non-intrusive testing with so no extra days needed.

ATTACHMENT V – Generic Type I Holdover Time Table

TABLE 1-A

SAE TYPE I FLUID HOLDOVER GUIDELINES ON ALUMINUM WING SURFACES FOR WINTER 2012-2013[1]

This table applies to aircraft with critical surfaces constructed predominantly or entirely of aluminum materials that have demonstrated satisfactory use of these holdover times.

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

Outside Air Temperature[2]		Approximate Holdover Times Under Various Weather Conditions (minutes)							
		Freezing Fog	Snow, Snow Grains or Snow Pellets			Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
Degrees Celsius	Degrees Fahrenheit		Very Light[3]	Light[3]	Moderate				
-3 and above	27 and above	11 – 17	18	11 – 18	6 – 11	9 – 13	4 – 6	2 – 5	CAUTION: No holdover time guidelines exist
below -3 to -6	below 27 to 21	8 – 13	14	8 – 14	5 – 8	5 – 9	4 – 6		
below -6 to -10	below 21 to 14	6 – 10	11	6 – 11	4 – 6	4 – 7	2 – 5		
below -10	below 14	5 – 9	7	4 – 7	2 – 4				

NOTES

1. Type I Fluid / Water Mixture is selected so that the freezing point of the mixture is at least 10°C (18°F) below outside air temperature.
2. Ensure that the lowest operational use temperature (LOUT) is respected.
3. Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5. No holdover time guidelines exist for this condition for 0°C (32°F) and below.
6. Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.

CAUTIONS

- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT VI – Generic Type III Holdover Time Table

TABLE 3

SAE TYPE III FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013

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

Outside Air Temperature[1]		Type III Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (minutes)							
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets: Very Light[2]	Light[2]	Moderate	Freezing Drizzle[3]	Light Freezing Rain	Rain on Cold Soaked Wing[4]	Other[5]
-3 and above	27 and above	100/0	20 – 40	35	20 – 35	10 – 20	10 – 20	8 – 10	6 – 20	CAUTION: No holdover time guidelines exist
		75/25	15 – 30	25	15 – 25	8 – 15	8 – 15	6 – 10	2 – 10	
		50/50	10 – 20	15	8 – 15	4 – 8	5 – 9	4 – 6		
below -3 to -10	below 27 to 14	100/0	20 – 40	30	15 – 30	9 – 15	10 – 20	8 – 10		
		75/25	15 – 30[6]	25[6]	10 – 25[6]	7 – 10[6]	9 – 12[6]	6 – 9[6]		
below -10	below 14	100/0	20 – 40	30	15 – 30	8 – 15				

NOTES

1. Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type III fluid cannot be used.
2. Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
3. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
4. No holdover guidelines exist for this condition for 0°C (32°F) and below.
5. Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
6. For outside air temperatures below -9°C (15.8°F) to -10°C (14°F), these holdover times only apply to aircraft with a take-off profile conforming to the high speed aerodynamic test criterion (refer to Section 8.1.6.1 f) of TP 14052E). If uncertain whether the aircraft performance conforms to this criterion, consult the aircraft manufacturer.

CAUTIONS

- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT VII – Dow Chemical UCAR Endurance EG106 Type IV Holdover Time Table

TABLE 4-D-E106

DOW CHEMICAL TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013[1]
UCAR™ ENDURANCE EG106

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

Outside Air Temperature[2]		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 and above	27 and above	100/0	2:05 – 3:10	0:40 – 1:20	1:10 – 2:00	0:50 – 1:15	0:20 – 2:00	
		75/25					CAUTION: No holdover time guidelines exist	
		50/50						
below -3 to -14	below 27 to 7	100/0	1:50 – 3:20	0:30 – 1:05	0:55 – 1:50[7]	0:45 – 1:10[7]		
		75/25						
below -14 to -27	below 7 to -16.6	100/0	0:30 – 1:05	0:15 – 0:30				

NOTES

1. These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
2. Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
3. Use light freezing rain holdover times in conditions of light snow mixed with light rain.
4. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5. No holdover guidelines exist for this condition for 0°C (32°F) and below.
6. Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
7. These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT VIII – Kilfrost ABC-S Plus Type IV Holdover Time Table

TABLE 4-K-ABC-S+

KILFROST TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013[1]
ABC-S PLUS

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

Outside Air Temperature[2]		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 and above	27 and above	100/0	2:10 – 4:00	1:15 – 2:00	1:50 – 2:00	1:05 – 2:00	0:25 – 2:00	
		75/25	1:25 – 2:40	0:45 – 1:15	1:00 – 1:20	0:30 – 0:50	0:10 – 1:20	
		50/50	0:30 – 0:55	0:15 – 0:30	0:15 – 0:40	0:15 – 0:20	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	0:55 – 3:30	1:00 – 1:45	0:25 – 1:35[7]	0:20 – 0:30[7]		
		75/25	0:45 – 1:50	0:35 – 1:00	0:20 – 1:10[7]	0:15 – 0:25[7]		
below -14 to -28	below 7 to -18.4	100/0	0:40 – 1:00	0:15 – 0:30				

NOTES

1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
3 Use light freezing rain holdover times in conditions of light snow mixed with light rain.
4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
7 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS

- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT IX – Clariant Safewing MP IV Launch Type IV Holdover Time Table

TABLE 4-C-LAUNCH

CLARIANT TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013[1]
SAFEWING MP IV LAUNCH

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

Outside Air Temperature[2]		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 and above	27 and above	100/0	4:00 – 4:00	1:05 – 1:45	1:30 – 2:00	1:00 – 1:40	0:15 – 1:40	CAUTION: No holdover time guidelines exist
		75/25	3:40 – 4:00	1:00 – 1:45	1:40 – 2:00	0:45 – 1:15	0:10 – 1:45	
		50/50	1:25 – 2:45	0:25 – 0:45	0:30 – 0:50	0:20 – 0:25		
below -3 to -14	below 27 to 7	100/0	1:00 – 1:55	0:50 – 1:20	0:35 – 1:40[7]	0:25 – 0:45[7]		
		75/25	0:40 – 1:20	0:45 – 1:25	0:25 – 1:10[7]	0:25 – 0:45[7]		
below -14 to -28.5	below 7 to -19.3	100/0	0:30 – 0:50	0:15 – 0:30				

NOTES
1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
3 Use light freezing rain holdover times in conditions of light snow mixed with light rain.
4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
7 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS
- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT X – Cryotech Polar Guard Advance Type IV Holdover Time Table

TABLE 4-CR-PG-A

CRYOTECH TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013[1]
POLAR GUARD ADVANCE

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

Outside Air Temperature[2]		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 and above	27 and above	100/0	2:50 – 4:00	1:20 – 1:50	1:35 – 2:00	1:15 – 1:30	0:15 – 2:00	CAUTION: No holdover time guidelines exist
		75/25	2:30 – 4:00	0:45 – 1:20	1:40 – 2:00	0:40 – 1:10	0:09 – 1:40	
		50/50	0:50 – 1:25	0:15 – 0:35	0:20 – 0:45	0:09 – 0:20		
below -3 to -14	below 27 to 7	100/0	0:55 – 2:30	0:55 – 1:15	0:35 – 1:35[7]	0:35 – 0:45[7]		
		75/25	0:40 – 1:30	0:35 – 1:00	0:25 – 1:05[7]	0:35 – 0:45[7]		
below -14 to -30.5	below 7 to -22.9	100/0	0:25 – 0:50	0:15 – 0:30				

NOTES
1 These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
3 Use light freezing rain holdover times in conditions of light snow mixed with light rain.
4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover guidelines exist for this condition for 0°C (32°F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
7 These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS
- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT XI – ABAX ECOWING AD-49 Type IV Holdover Time Table

TABLE 4-A-Ecowing AD-49

ABAX TYPE IV FLUID HOLDOVER GUIDELINES FOR WINTER 2012-2013[1]
ECOWING AD-49

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

Outside Air Temperature[2]		Type IV Fluid Concentration Neat Fluid/Water (Volume %/Volume %)	Approximate Holdover Times Under Various Weather Conditions (hours:minutes)					
Degrees Celsius	Degrees Fahrenheit		Freezing Fog	Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 and above	27 and above	100/0	3:20 – 4:00	1:10 – 1:50	1:25 – 2:00	1:00 – 1:25	0:10 – 1:55	
		75/25	2:25 – 4:00	1:20 – 1:40	1:55 – 2:00	0:50 – 1:30	0:10 – 1:40	
		50/50	0:25 – 0:50	0:15 – 0:25	0:15 – 0:30	0:10 – 0:15	CAUTION: No holdover time guidelines exist	
below -3 to -14	below 27 to 7	100/0	0:20 – 1:35	1:10 – 1:50	0:25 – 1:25[7]	0:20 – 0:25[7]		
		75/25	0:30 – 1:10	1:20 – 1:40	0:15 – 1:05[7]	0:15 – 0:25[7]		
below -14 to -26	below 7 to -14.8	100/0	0:25 – 0:40	0:15 – 0:30				

NOTES
1. These holdover times are derived from tests of this fluid having a viscosity as listed in Table 9.
2. Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I when Type IV fluid cannot be used.
3. Use light freezing rain holdover times in conditions of light snow mixed with light rain.
4. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5. No holdover guidelines exist for this condition for 0°C (32°F) and below.
6. Heavy snow, ice pellets, moderate and heavy freezing rain, and hail.
7. These holdover times only apply to outside air temperatures to -10°C (14°F) under freezing drizzle and light freezing rain.

CAUTIONS
- **The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable holdover time table cell.**
- **The time of protection will be shortened in heavy weather conditions, heavy precipitation rates, or high moisture content.**
- **High wind velocity or jet blast may reduce holdover time.**
- **Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.**
- **Fluids used during ground de/anti-icing do not provide in-flight icing protection.**

ATTACHMENT XII– Ice Pellet Allowance Time Table

Transport Canada Holdover Time Guidelines **Winter 2012-2013**

TABLE 11

ICE PELLET ALLOWANCE TIMES FOR WINTER 2012-2013

This table is for use with SAE Type IV undiluted (100/0) fluids only.
All Type IV fluids are propylene glycol based with the exception of Dow Chemical EG106 which is ethylene glycol based.

	OAT -5°C and above	OAT less than -5°C to -10°C	OAT less than -10°C
Light Ice Pellets	50 minutes	30 minutes	30 minutes[1]
Moderate Ice Pellets	25 minutes[2]	10 minutes	10 minutes[1]
Light Ice Pellets Mixed with Light or Moderate Freezing Drizzle	25 minutes	10 minutes	**Caution: No allowance times currently exist**
Light Ice Pellets Mixed with Light Freezing Rain	25 minutes	10 minutes	
Light Ice Pellets Mixed with Light Rain	25 minutes[3]		
Light Ice Pellets Mixed with Moderate Rain	25 minutes[4]		
Light Ice Pellets Mixed with Light Snow	25 minutes	15 minutes	
Light Ice Pellets Mixed with Moderate Snow	10 minutes		

NOTES

1. No allowance times exist for propylene glycol (PG) fluids, when used on aircraft with rotation speeds less than 115 knots. (For these aircraft, if the fluid type is not known, assume zero allowance time).
2. Allowance time is 15 minutes for propylene glycol (PG) fluids or when the fluid type is unknown.
3. No allowance times exist in this condition for temperatures below 0°C; consider use of light ice pellets mixed with light freezing rain.
4. No allowance times exist in this condition for temperatures below 0°C.

ATTACHMENT XIII – Task List for Setup and Actual Tests

No.	Task	Person	Status
	Planning and Preparation		
1	Co-ordinate with NRC wind tunnel personnel	MR/JD	
2	Ensure fluid is received by NRC and is stored outdoors	MR/JD	
3	Check with NRC the status of the testing site, tunnel etc	MR	
4	Arrange for hotel accommodations for APS personnel	VZ	
5	Arrange truck rental	VZ	
6	Arrange for ice and freezer delivery	DY	
7	Organize personnel travel to Ottawa;	VZ	
8	Hire YOW personnel	VZ	
9	Complete contract for YOW personnel	VZ/PG	
10	Co-ordinate with APS photographer	MR	
11	Ensure availability of freezing rain sprayer equipment;	MR	
12	Prepare and Arrange Office Materials for YOW	VZ	
13	Prepare Data forms and procedure	VZ	
14	Prepare Test Log and Merge Historical Logs for Reference (See JD with it)	VZ	
15	Prepare weather forecast spreadsheet	VZ	
16	Prepare historical falling ball records spreadsheet	VZ	
17	Finalize and complete list of equipment/materials required	MR	
18	Prepare and Arrange Site Equipment for YOW	DY	
19	Ensure proper functioning of ice pellet dispenser equipment;	MR	
20	Review IP/ZR/SN dispersal techniques and location	VZ/MR	
21	Update IP Rate File (if necessary)	VZ/MR	
22	Check weather prior to finalizing test dates and Day vs. Night Shift, Start Time	MR/JD	
23	Arrange for pallets to lift up 1000L totes (if applicable)	MR	
24	Purchase new 20 L containers (as necessary)	DY	
25	Complete purchase list and shopping	VZ	
26	Pack and leave YUL for YOW on Monday Jan 7th for AM start on Jan 8th	APS	
	Tuesday Jan 8		
27	Safety Briefing & Training (APS/YOW)	MR	
28	Unload Truck and organize equipment in lower, middle, or office area	APS	
29	Verify and Organize Fluid Received (labels and fluid receipt forms)	DY/JS	
30	Transfer Fluids from 1000 L Totes to 20 L containers	DY/JS	
31	Collect fluid samples for viscosity at APS office and for Falling Ball	DY/VZ	
32	Conduct falling ball verification	DY/VZ	
33	Confirm ice and freezer delivery	DY	
34	Setup general office and testing equipment	VZ	
35	Setup Projector	VZ	
36	Setup Printer	VZ	
37	Setup rate station (if necessary)	DY	
38	Setup IP/SN manufacturing material in reefer truck	JS	
39	Test and prepare IP dispensing equipment	JS	
40	Train IP making personnel (ongoing)	JS/YOW	
41	Co-ordinate fabrication of ice pellets/snow	VZ/JS	
42	IP/SN/ZR Calibration (if necessary)	DY/VZ/MR	
43	Start IP manufacturing	JS	
44	Mark wing (only if requested);	VZ	
45	Setup Still and Video Cameras same as 2010-11	BG/JsD	
46	Verify photo and video angles, resolution, etc, against 2010-11/11-12	BG/JsD/MR	
47	Document new final camera and flash locations	VZ/BG/JsD	
48	General safety briefing and update on testing	APS/NRC/YOW	
49	Dry Run of tests with APS and NRC (if necessary)	APS/NRC	
50	Start Testing (Dry wing tests may be possible while setup occurs)	APS/NRC	
	Each Testing Day		
51	Check with NRC the status of the testing site, tunnel, weather etc	MR	
52	Deicide personnel requirements for following day for 24hr notice	MR/WU	
53	Prepare equipment and fluid to be used for test	DY	
54	Manufacture ice pellets	JS/YOW	
55	Prepare photography equipment	BG	
56	Prepare data forms for test	VZ	
57	Conduct tests based on test plan	APS	
58	Modify test plan based on results obtained	WU/JD/MR	
59	Update ice pellet, snow, raw ice, and fluid Inventory (end of day)	VZ/JS	
60	Update Test Log and Test Plan (ongoing and end of day)	VZ	

ATTACHMENT XIV – General Form/ Calibration

GENERAL FORM (EVERY CALIBRATION TEST)

DATE: ______________________ RUN # (Plan #): ______________

OJECTIVE: ☐ Angle of Attack Sweeps ☐ Flow Visualization ☐ Surface Roughness Tests

AIR TEMPERATURE (°C) BEFORE TEST: __________ AIR TEMPERATURE (°C) AFTER TEST: __________

TUNNEL TEMPERATURE (°C) BEFORE TEST: __________ TUNNEL TEMPERATURE (°C) AFTER TEST: __________

WIND TUNNEL START TIME: __________ ROTATION ANGLE: __________

WIND TUNNEL END TIME: __________ PROJECTED SPEED (S/KTS): __________

FLAP SETTING (20°, 0°): __________

OIL APPLIED: Y / N OIL DETAILS: ______________________

☐ Full Wing ☐ Partial Wing (describe) ______________________

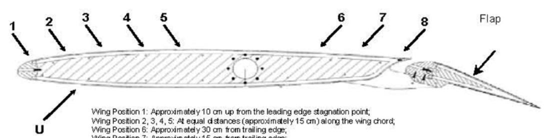
GRIT APPLIED: Y / N GRIL DETAILS: ______________________

☐ Full Wing ☐ Partial Wing (describe) ______________________

____

OTHER APPLIED: Y / N OTHER DETAILS: ______________________

☐ Full Wing ☐ Partial Wing (describe) ______________________

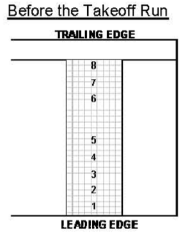


Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge;
Wing Position 9: Midway up the flap; and
Underside: Approximately 40 cm up from the leading edge stagnation point.

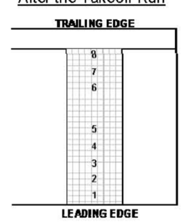
☐ Small Endplates

☐ Large Endplates

Before the Takeoff Run



After the Takeoff Run



COMMENTS : ______________________

HANDWRITTEN BY:

☐ Check if further details are available behind this sheet

ATTACHMENT XV – General Form

Form 1

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:** ______

ATTACHMENT XVI – Wing Temperature, Fluid Thickness and Fluid Brix Form

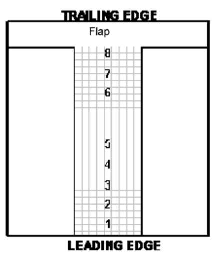
Date: ____________________ Run: ____________

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:			

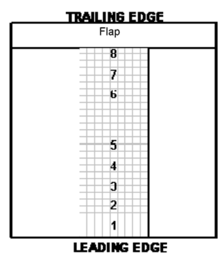
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2			
3			
4			
5			
6			
7			
8			
Flap			
Time:			

Wing and Plate Condition
After the Takeoff Run
Time: ________

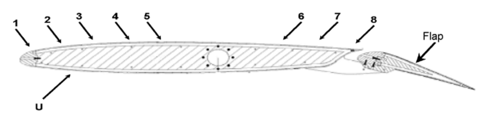


Comments: ____________________

Wing and Plate Condition
Before 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: ____________________

ASSISTED BY: ____________________

ATTACHMENT XVII – Example Ice Pellet Dispensing Form

WING TRAILING EDGE

8 ft = 24.4 dm

6 ft = 18.3 dm

DISPENSOR #3								DISPENSOR #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
	DISPENSOR #2								DISPENSOR #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 Dispensor	323	g

IP needed for entire test

Total amount of IP in Each Dispensor	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 Dispensor" in grams. **(Each Dispensor 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 Dispensor 1-foot to the left.
8. Once a Dispensor 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 Dispensor Stands must be 1-foot (12 inches) from the Leading Edge (LE)

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

- Height of the Stand must be 4-feet from bottom of the dispensor

ATTACHMENT XVIII – Example Snow Dispensing Form

WING TRAILING EDGE

← 8 ft = 24.4 dm →

6 ft = 18.3 dm

DISPENSOR #3								DISPENSOR #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
	DISPENSOR #2								DISPENSOR #1						

WING LEADING EDGE

Precipitation Type	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	84	g
In each Dispensor	336	g

Snow needed for entire test

In each Dispensor	336	g
Total Amount Snow Needed for Entire Test	1344	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 Dispensor 1-foot to the left.
8. Once a Dispensor 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 Dispensor Stands must be 1-foot (12 inches) from the Leading Edge (LE)

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

- Height of the Stand must be 4-feet from bottom of the dispensor

ATTACHMENT XIX – Example Snow Dispensing Form

Precipitation Type	Sifted Snow
Date	
Run #	

* *Field to be manipulated*

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

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

Snow needed per 5 minutes

In each position	66
In each Dispensor	265

Snow needed for entire test

In each Dispensor	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 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 Dispensor 1-foot to the left.
8. Once a Dispensor 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 Dispensor Stands must be 1-foot (12 inches) from the Leading Edge (LE)

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

- Height of the Stand must be 4-feet from bottom of the dispensor

- 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 XX – 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 - Contamiantion visible, adherence of contamination

Before Take-off Run

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

At Rotation

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

Expected Lift Loss (%)

After Take-off Run

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

Additional Observations:

OBSERVER: ________________________

ATTACHMENT XXI – Fluid Receipt Form

(Consider using electronic auto-fill format)

SECTION A - SITE

☐ HOT SAMPLE ☐ RESEARCH/OTHER SAMPLE

Receiving Location: ____________________ **Date of Receiving:** ____________________

Manufacturer: ________________ **Fluid Name:** ____________________ **Fluid Type:** ______

Date of Production: ____________________ **Batch #:** ____________________

Fluid Dilution:	______	______	______
Fluid Quantity:	___ x ___ L = _____ L	___ x ___ L = _____ L	___ x ___ L = _____ L
APS Measured BRIX:	______	______	______

Note any additional information included on fluid containers:

Received by: ____________________
(PRINT NAME)
on: ____________________
(DATE)

SECTION B - OFFICE

Fluid Code Assigned: 100/0 ______ 75/25 ______ 50/50 ______ Type I ______

Viscosity Information Received:[1] ☐ **Viscosity Measured:**[1] ☐

WSET Sample Sent to AMIL: ☐ **WSET Result Received:** ☐

FFP Curves Received:[2] ☐

[1] Type II/III/IV fluids only
[2] Type I fluids only

ATTACHMENT XXII – 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 XXIII – 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);
- Compare the aerodynamic performance.

Test Plan

Four or more tests are anticipated at a minimum. If LOUT temperatures for neat fluids are not likely to occur, investigate the possibility of using diluted fluids to obtain a higher LOUT.

ATTACHMENT XXIV – 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 de-icing 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/dm²/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/dm²/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 are anticipated. See previous reports for suggested test plan.

ATTACHMENT XXV – 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;
- Compare aerodynamic performance results to fluid only or fluid and contamination tests at the same temperature.

Test Plan

One to four tests are anticipated. Previous work should be referenced to identify starting levels of heavy contamination.

ATTACHMENT XXVI – Procedure: Small Hail

Background

Reports from primarily Asian operators have indicated that small hail can occur frequently during winter operations. The small hail will generally occur above freezing conditions; however no guidance for operating in the conditions is currently available. Questions have been raised as to whether the ice pellet allowance times can be used due to similarity in precipitation type. Although this concern has only been raised by Asian operators, it can be assumed that similar conditions can be expected by North American operators. WMO defines small hail as snow pellets encapsulated by ice, a precipitation halfway between graupel and hail.

Objective

To investigate the fluid aerodynamic flow-off characteristics of anti-icing fluid with contamination with small hail and to compare the results to ice pellets.

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 small hail for an exposure time derived from the current ice pellet allowance time table as a starting point;
- Record lift data, visual observations, and manually collected data;
- Conduct a fluid only baseline test at the same temperature;
- Compare the aerodynamic performance.

Test Plan

One to four tests are anticipated. A meteorologist should be consulted prior to the conduct to narrow down the exact conditions and temperatures at which small hail will occur, as well as to obtain the desired small hail diameter.

ATTACHMENT XXVII – Procedure: Frost Simulation in the Wind Tunnel

Background

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

Objective

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

Methodology

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

Test Plan

One or two tests is anticipated.

ATTACHMENT XXVIII – Procedure: Wind Tunnel Test Section Cooling

Background

Recent wind tunnel research has been limited by the ambient temperature in wind tunnel test section; in sunny conditions, the radiation will raise the temperature in the test section making testing difficult. To mitigate this effect, testing is often conducted overnight, however in some cases, even body heat from people working in the test area (specifically during long precipitation exposure tests) can effect the temperature. It was recommended that initial testing be performed to investigate whether it would be feasible to install a cooling system in the wind tunnel, or to possibly use mitigation tactics such as blower fans to increase airflow and stabilize temperature.

Objective

To investigate the feasibility of stabilizing the temperature in the PIWT test section by using mitigation tactics or technologies.

Methodology

This work is exploratory, so no exact procedure exists. A more specific methodology may be determined on site following a brain-storm with onsite technicians.

Test Plan

One or two tests is anticipated, or could be ongoing during the testing if non-intrusive.

ATTACHMENT XXIX – Procedure: Flaps/Slats Testing to Support YMX Tests

Background

Flaps/slats testing has been conducted with the support of UPS during the winter of 2011-12, and is scheduled to continue during the winter of 2012-13. The initial results have indicated that extended configurations can result in earlier fluid failure on the flap and slats as compared to the main section of the wing. It was recommended that testing in the wind tunnel be conducted to evaluate how significant the aerodynamic penalties would be from having failed fluid in these isolated areas.

Objective

To investigate the aerodynamic performance degradation associated with failed fluid on flaps and slats.

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/dm²/h) for an exposure time derived from the HOT table based on the tunnel temperature at the time of the test;
- Simulate early fluid failure on the fixed leading edge by applying higher rates of contamination on this area (record additional amounts);
- The flap is a hinged flap, so will be subject to early failure by design;
- Record lift data, visual observations, and manually collected data;
- Conduct a fluid only baseline test at the same temperature;
- Compare the aerodynamic performance;
- Consideration should be given to conducting Type I tests.

Test Plan

Two to four comparative tests are anticipated.

ATTACHMENT XXX – Procedure: Mixed HOT Conditions

Background

As the accuracy of meteorological reporting continues to improve, there has been a need to provide improved guidance material during these transitional periods of mixed precipitation. During the winter of 2008-09, guidance material was developed for operations during light snow mixed with light rain conditions. As a result of this work, there was industry interest in guidance material for operations during light freezing rain and moderate snow conditions as well as other mixed conditions. The objective of these tests is to collect data to determine if the current HOT guidelines can be expanded to include other operational mixed conditions which may be of current interest to industry.

Objective

To investigate if the current HOT guidelines can be expanded to include mixed conditions i.e. light freezing rain and moderate snow conditions.

Methodology

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

- For a chosen fluid, conduct a test simulating mixed conditions for an exposure time derived from the HOT table based on relative condition.
- Record lift data, visual observations, and manually collected data;
- Conduct a fluid only baseline test at the same temperature; or
- Conduct a test with an existing relative HOT condition to evaluate the severity of the condition;
- Compare the aerodynamic performance.
- If the mixed condition results are severe, repeat the test with a reduced exposure time, if the results are good, repeat the test with a increased exposure time.

Test Plan

Two to four comparative tests are anticipated.

ATTACHMENT XXXI – Procedure: Spot Deicing During CSW Frost Conditions

Background

The fundamental difference between both types of frost is how the wing skin temperature is cooled below ambient: radiation cooling versus conduction cooling. During natural active frost, the wing skin temperature will be cooled below ambient temperature as a result of radiation cooling from the cold clear sky. During cold soak wing conditions, however, the wing skin temperature is cooled and maintained at a temperature below ambient as a result of conduction cooling from the cold fluid stored inside the wing; either the aircraft was refueled with cold fuel, or following a flight, the wing and fluid will be cold soaked. One test was conducted in 2011-12 to investigate the aerodynamic effects of CSW frost on a deiced airfoil protected with Type I fluid. It was recommended that testing be repeated with thickened Type IV fluid.

Objective

To investigate the aerodynamic effects of CSW frost on a deiced airfoil protected with Type IV fluid.

Methodology

- Apply fluid to wing section (2 areas of approximately 315cm²);
- Run the wind tunnel and collect data; and
- Compare results to baseline uncontaminated tests.

Test Plan

One to two tests are anticipated.

ATTACHMENT XXXII – Procedure: Snow on an Un-Protected Wing

Background

In colder northern operations, it is common for aircraft to depart with "loose, dry, un-adhered snow" on present on their wing sections. Although it is assumed most or all of this contamination will be removed at the time of rotation, it is unknown whether a certain level of contamination will reduce aerodynamic performance. Preliminary testing has demonstrated fluid seepage from the airfoil can lead to snow diluting and adhering to the airfoil during rotation; this effect has yet to be substantiated will operational data. During the winter of 2011-12, a video was leaked on the internet of an eastern European aircraft taking off with significant amounts of snow on the wing. As a result, additional wind tunnel testing was conducted during the winter of 2011-12. It was recommended that additional testing investigate the aerodynamic performance of a wing section contaminated with dry, un-adhered snow versus wet or humid snow.

Objective

To investigate the aerodynamic performance of a wing section contaminated with dry, un-adhered snow versus wet or humid 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.

- Ensure the wing section and tunnel temperature are well below freezing (-5ºC and below);
- Ensure the wing section is clean, dry, and free of any forms of contamination;
- Apply loose, dry snow contamination to the wing section;
- Record lift data, visual observations, and manually collected data;
- Compare the results to baseline fluid only and dry wing test results;

Test Plan

One to four comparative tests are anticipated.

ATTACHMENT XXXIII – Procedure: Feasibility of Ice Pellet Testing at Higher Speeds

Background

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

Objective

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

Methodology

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

Test Plan

One or two tests are anticipated, however more tests may be required based on the results.

ATTACHMENT XXXIV – Procedure: Light and Very Light Snow HOT's

Background

Holdover time determination systems have been developed to provide greater accuracy for determining rate of precipitation and allowing for a better use of the holdover time tables. Some recent discussion has been raised about HOT's for light and very light snow with respect to the fluid condition at the end of the several hour holdover time and potential concerns with fluid dripping off and thinning out. It was recommended that some preliminary testing be conducted in the wind tunnel to see how the fluid fails on an airfoil and to investigate the resulting aerodynamic effects. Limited testing was conducted during the winter of 2011-12 and it was recommended that testing continue for 2012-13.

Objective

To investigate the potential light and very light snow HOT's failure patterns and the respective effects on aerodynamic performance.

Methodology

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

- For a chosen fluid (ABC-S Plus suggested), conduct a test simulating very light snow conditions for an exposure time (72 minutes for rate of 3 $g/dm^2/h$) derived from the fluid specific HOT regression equations;
- Evaluate the condition of fluid and any potential dry-out or thinning of fluid at end of exposure period;
- Record lift data, visual observations, and manually collected data.

Test Plan

One to four comparative tests are anticipated for comparison to a baseline condition. Previous 2011-12 work should be referenced when developing test plan.

ATTACHMENT XXXV – Procedure: Windshield Washer Used as Type I Deicer

Background

Based on recent industry reports, it has become apparent that in more remote airports or with general aviation aircraft with smaller operations, aircraft deicing is not being conducted with SAE aircraft ground deicing Type I fluid, but rather with off-the-shelf windshield washer fluid. Although the basic chemistry of the windshield washer fluid may be similar, questions regarding the fluid freeze point, holdover time, aerodynamics, and material compatibility have been raised. It was recommended that some preliminary testing be conducted to investigate fluid flow off in the wind tunnel with and without contamination. Limited test was conducted during the winter of 2011-12. It was recommended that testing should continue if necessary based on operational needs.

Objective

To evaluate the holdover time and aerodynamic effects windshield washer fluid when used a substitute for an aircraft ground deicing Type I fluid.

Methodology

- Purchase various formulations of windshield washer fluid with varying freeze points;
- Apply fluid heated to 20ºC using a garden sprayer;
- Expose to simulated freezing contamination (snow, freezing rain, or ice pellets). The exposure time is to be determined based on Type I fluid HOT's (45 minutes at a rate of 0.3 g/dm^2/h);
- Document condition of the wing;
- Run the wind tunnel and collect data; and
- Compare results to baseline uncontaminated windshield washer tests and potentially with standard Type I tests.

Test Plan

No testing is planned unless indicated otherwise by TC.

ATTACHMENT XXXVI – Procedure: Effect of Fluid Seepage on Dry Wing Performance

Background

Preliminary observations have indicated that fluid seepage from the airfoil can lead to lift losses and other aerodynamic impacts. This is especially of concern after a long series of flud tests followed by a baseline dry wing test. It was recommended that testing investigate the aerodynamic impacts of residual fluid seepage on the airfoil performance.

Objective

To investigate the aerodynamic impacts of residual fluid seepage on the airfoil performance.

Methodology

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

- To be conducted following a long series of fluid and/or contamination tests;
- Ensure the wing section is clean, dry, and free of any forms of contamination;
- Record lift data, visual observations, and manually collected data;
- Compare results to the first dry wing test of the season;
- Re-clean the wing using a wet-vac or other alternative method to try and remove any residual fluid;
- Record lift data, visual observations, and manually collected data;
- Compare the results;

Test Plan

One to three comparative tests are anticipated

ATTACHMENT XXXVII – Procedure: 2nd Wave of Fluid during Rotation

Background

Previous wind tunnel testing has shown that during a simulated take-off roll following de/anti-icing, fluid will shear off the wing section, however a small amount of fluid can remain trapped along the leading edge at the stagnation point. This "trapped" fluid begins to flow over the wing only once the wing is rotated; the stagnation point shifts below the leading edge, and the "trapped" fluid begins to shear off as a second wave. There is limited information as to the aerodynamic effects of this second wave of fluid, therefore it was recommended that preliminary testing be conducted to collect aerodynamic and observational data.

Objective

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

Methodology

This work is exploratory, so no exact procedure exists. A more specific methodology may be determined on site following a brain-storm with onsite technicians and NASA experts. It is expected that the general methodology to be used during these tests will be in accordance with the methodologies used for typical fluid only testing.

One test methodology may be to install a HD video camera to the end plates of the wing section during specific fluid tests to obtain high quality video documentation of the fluid flow-off. The video camera should be focused on the leading edge stagnation point.

Another possible test methodology may include:

- Apply fluid to wing section;
- Run the wind tunnel up to rotation speed and stop;
- Squeegee all fluid aft of the leading edge;
- Re-run the wind tunnel and do a full rotation; and
- Compare results to fluid only and dry uncontaminated tests.

Test Plan

One to four tests are anticipated.

APPENDIX A

PRESENTATION: WIND TUNNEL TESTING
WINTER 2012-13

WIND TUNNEL TESTING WINTER 2012-13

Objective: PRE TESTING	
Priority:	1
Number of days:	2 *(December 19-20, 2012)*
Number of tests:	TBD
Description of tests:	See Andy Broeren test plan

WIND TUNNEL TESTING WINTER 2012-13

Objective: DRY WING BASELINES REPEATABILITY	
Priority:	1
Number of days:	1 *(allocated based on 20 days)*
Number of tests:	2 per day
Description of tests:	Dry wing run @ 8° (1 x every start of day)
	Dry wing run @ stall (1 x every start of day)

WIND TUNNEL TESTING WINTER 2012-13

Objective: IP FLOW OFF ISSUES (IP- & IP MOD <-10°C)	
Priority:	1
Number of days:	3
Number of tests:	30
Description of tests:	IP- @ <-10°C - 100 knots / fluid *(30 min exposure)*
	IP- @ <-10°C - 115 knots / fluid *(30 min exposure)*
	IP Mod @ <-10°C - 100 knots / fluid *(10 min exposure)*
	IP Mod @ <-10°C - 115 knots / fluid *(10 min exposure)*
	IP Mod @ <-10°C - 100 knots / fluid *(5 min exposure)*
	IP Mod @ <-10°C - 115 knots / fluid *(5 min exposure)*
Fluids:	ABC-S Plus, Launch, AD-49, Max-Flight, Polar Guard Advance

WIND TUNNEL TESTING WINTER 2012-13

Objective: ROGIDS PIGGYBACK TESTING IN WT	
Priority:	1
Number of days:	0
Number of tests:	TBD
Description of tests:	*Non-intrusive testing with PV Labs, so no extra days needed. Observe icing tests with different conditions i.e. Ice Pellets.*

WIND TUNNEL TESTING WINTER 2012-13

Objective: ICE PHOBIC COATING R&D (1 of 3)	
Priority:	1
Number of days:	3
Number of tests:	53 *(total for flow-off, adhesion and visual comparison objectives)*
Description of tests:	Flow-off *(13 tests)*
	Dry wing @ <-10°C - 100 knots *(baseline)*
	IP Mod @ <-10°C - 100 knots / coating *(10 min exposure)*
	IP Mod @ <-10°C - 100 knots with one coating using Max-Flight LOWV fluid *(10 min exposure)*
Fluids:	Max-Flight, none
Coatings:	C0: *Skin with no coating* C1: *Skin treated with coating #1* C2: *Skin treated with coating #2* C3: *Skin treated with coating #3* C4: *Skin treated with coating #4* C5: *baseline test*

WIND TUNNEL TESTING WINTER 2012-13

Objective: ICE PHOBIC COATING R&D (2 of 3)	
Description of tests:	Adhesion *(30 tests)*
	ZR @ -10°C - 100 knots / coating *(20 min exposure with fluid)*
	ZR @ -10°C - 100 knots / coating *(20 min exposure without fluid)*
	IP/ZR @ -10°C - 100 knots / coating *(20 min exposure)*
	BASELINE @ -10°C - 100 knots / coating *(fluid only test)*
	IP-/ZR @ -5 to -10°C - 80 knots x any 2 different coatings
	IP-/ZR @ -5 to -10°C - 115 knots x any 2 different coatings
	SN @ -5 to -10°C - 100 knots x one coating *(no fluid)*
	SN @ -5 to -10°C - 115 knots x one coating *(no fluid)*
Fluids:	EG106
Coatings:	C0: *Skin with no coating* C1: *Skin treated with coating #1* C2: *Skin treated with coating #2* C3: *Skin treated with coating #3* C4: *Skin treated with coating #4* C5: *baseline test*

WIND TUNNEL TESTING WINTER 2012-13

Objective: ICE PHOBIC COATING R&D (3 of 3)	
Description of tests:	Visual Comparison *(10 tests)* *using 2 coatings per run, visually compare the results*
	ZR @ <-5°C - 100 knots / coating *(exposure TBD)*
	BASELINE @ <-5°C - 100 knots / coating *(fluid only test)*
Fluids:	EG106
Coatings*:	C0 & C5 C1 & C5 C1 & C2 C3 & C4 C0 & one of C1 or C2 or C3 or C4

* C0: *Skin with no coating*
C1: *Skin treated with coating #1*
C2: *Skin treated with coating #2*
C3: *Skin treated with coating #3*
C4: *Skin treated with coating #4*
C5: *baseline test*

WIND TUNNEL TESTING WINTER 2012-13

Objective: EFFECT OF ICE PHOBIC COATING BLDT (1 of 3)	
Priority:	1
Number of days:	1
Number of tests:	15 *(Total for Type III 100/0, Type III 75/25 and Type IV 100/0)*
Description of tests:	Type III 100/0 LOUT expansion *(6 tests)*
	BASELINE@ -16.5°C - 67 knots / coating
Fluids:	MP III 2031 ECO *(100/0)*
Coatings:	C0: *Skin with no coating* C1: *Skin treated with coating #1* C2: *Skin treated with coating #2* C3: *Skin treated with coating #3* C4: *Skin treated with coating #4* C5: *baseline test*

WIND TUNNEL TESTING WINTER 2012-13

Objective: EFFECT OF ICE PHOBIC COATING BLDT (2 of 3)	
Description of tests:	Type III 75/25 LOUT expansion *(3 tests)*
	BASELINE@ -9°C - 67 knots / coating
Fluids:	MP III 2031 ECO *(75/25)*
Coatings:	C0: *Skin with no coating; and* C5: *baseline test;* *With the choice of one of the following:* C1 : *Skin treated with coating #1; or* C2: *Skin treated with coating #2; or* C3: *Skin treated with coating #3; or* C4: *Skin treated with coating #4.*

WIND TUNNEL TESTING WINTER 2012-13

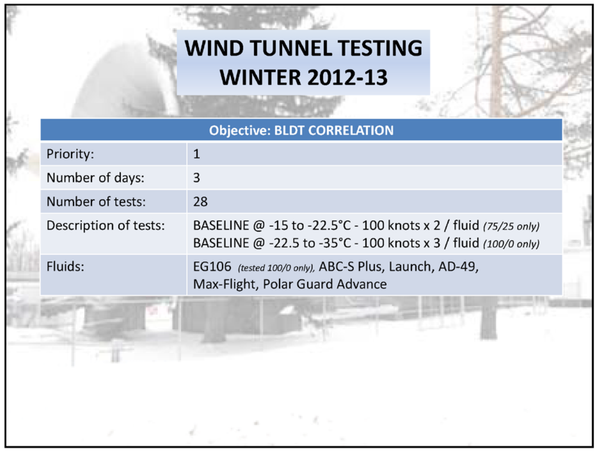
Objective: EFFECT OF ICE PHOBIC COATING BLDT (3 of 3)	
Description of tests:	Type IV LOUT expansion *(6 tests)*
	BASELINE @ -26°C - 100 knots / coating
Fluids:	AD-49 *(100/0)*
Coatings:	C0: *Skin with no coating* C1: *Skin treated with coating #1* C2: *Skin treated with coating #2* C3: *Skin treated with coating #3* C4: *Skin treated with coating #4* C5: *baseline test*

WIND TUNNEL TESTING WINTER 2012-13

Objective: EVALUATION OF STALLWING SENSOR	
Priority:	1
Number of days:	1
Number of tests:	10
Description of tests:	*Ensure that the sensor is non intrusive.* BASELINE @ ANY°C at stall x 2 *(with sensor)* BASELINE @ ANY°C at stall x 2 *(without sensor)*
Fluids:	EG106, none
Description of tests:	*Ensure that the sensor is working* IP MOD @ ANY°C at stall *(15-35 min exposure EG106 only)* BASELINE @ ANY°C at stall *(Type I fluid only)*
Fluids:	EG106 *(for IP Mod)* and Type I Fluid *(TBD, for baseline)*

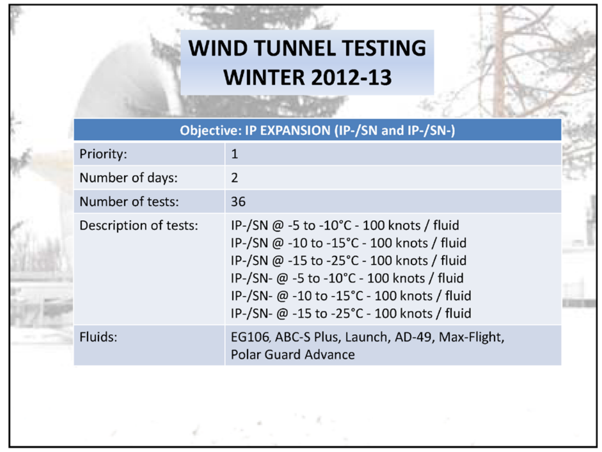
WIND TUNNEL TESTING WINTER 2012-13

Objective: EFFECT OF VISCOSITY ON FLUID AERODYNAMICS	
Priority:	2.1
Number of days:	2
Number of tests:	16
Description of tests:	BASELINE @ below -20°C - 100 knots/ fluid *(low viscosity)* BASELINE @ below -20°C - 100 knots/ fluid *(mid viscosity)* BASELINE @ -20°C and above - 100 knots / fluid *(low viscosity)* BASELINE @ -20°C and above - 100 knots / fluid *(mid viscosity)*
Fluids:	ABC-S Plus, Launch, AD-49, Polar Guard Advance



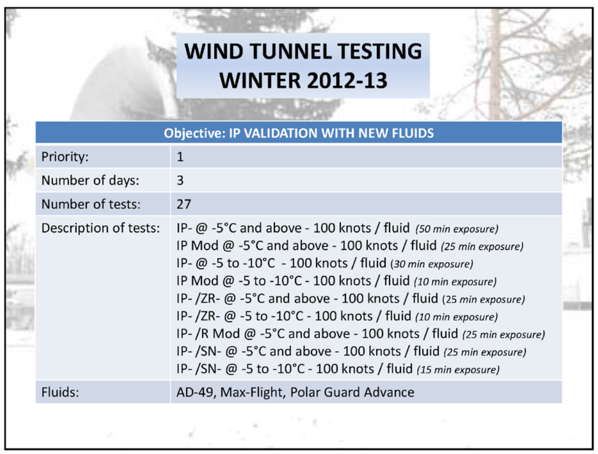
WIND TUNNEL TESTING WINTER 2012-13

Objective: BLDT CORRELATION	
Priority:	1
Number of days:	3
Number of tests:	28
Description of tests:	BASELINE @ -15 to -22.5°C - 100 knots x 2 / fluid *(75/25 only)* BASELINE @ -22.5 to -35°C - 100 knots x 3 / fluid *(100/0 only)*
Fluids:	EG106 *(tested 100/0 only)*, ABC-S Plus, Launch, AD-49, Max-Flight, Polar Guard Advance



WIND TUNNEL TESTING WINTER 2012-13

Objective: IP EXPANSION (IP-/SN and IP-/SN-)	
Priority:	1
Number of days:	2
Number of tests:	36
Description of tests:	IP-/SN @ -5 to -10°C - 100 knots / fluid IP-/SN @ -10 to -15°C - 100 knots / fluid IP-/SN @ -15 to -25°C - 100 knots / fluid IP-/SN- @ -5 to -10°C - 100 knots / fluid IP-/SN- @ -10 to -15°C - 100 knots / fluid IP-/SN- @ -15 to -25°C - 100 knots / fluid
Fluids:	EG106, ABC-S Plus, Launch, AD-49, Max-Flight, Polar Guard Advance



WIND TUNNEL TESTING WINTER 2012-13

Objective: IP VALIDATION WITH NEW FLUIDS	
Priority:	1
Number of days:	3
Number of tests:	27
Description of tests:	IP- @ -5°C and above - 100 knots / fluid *(50 min exposure)* IP Mod @ -5°C and above - 100 knots / fluid *(25 min exposure)* IP- @ -5 to -10°C - 100 knots / fluid *(30 min exposure)* IP Mod @ -5 to -10°C - 100 knots / fluid *(10 min exposure)* IP- /ZR- @ -5°C and above - 100 knots / fluid *(25 min exposure)* IP- /ZR- @ -5 to -10°C - 100 knots / fluid *(10 min exposure)* IP- /R Mod @ -5°C and above - 100 knots / fluid *(25 min exposure)* IP- /SN- @ -5°C and above - 100 knots / fluid *(25 min exposure)* IP- /SN- @ -5 to -10°C - 100 knots / fluid *(15 min exposure)*
Fluids:	AD-49, Max-Flight, Polar Guard Advance

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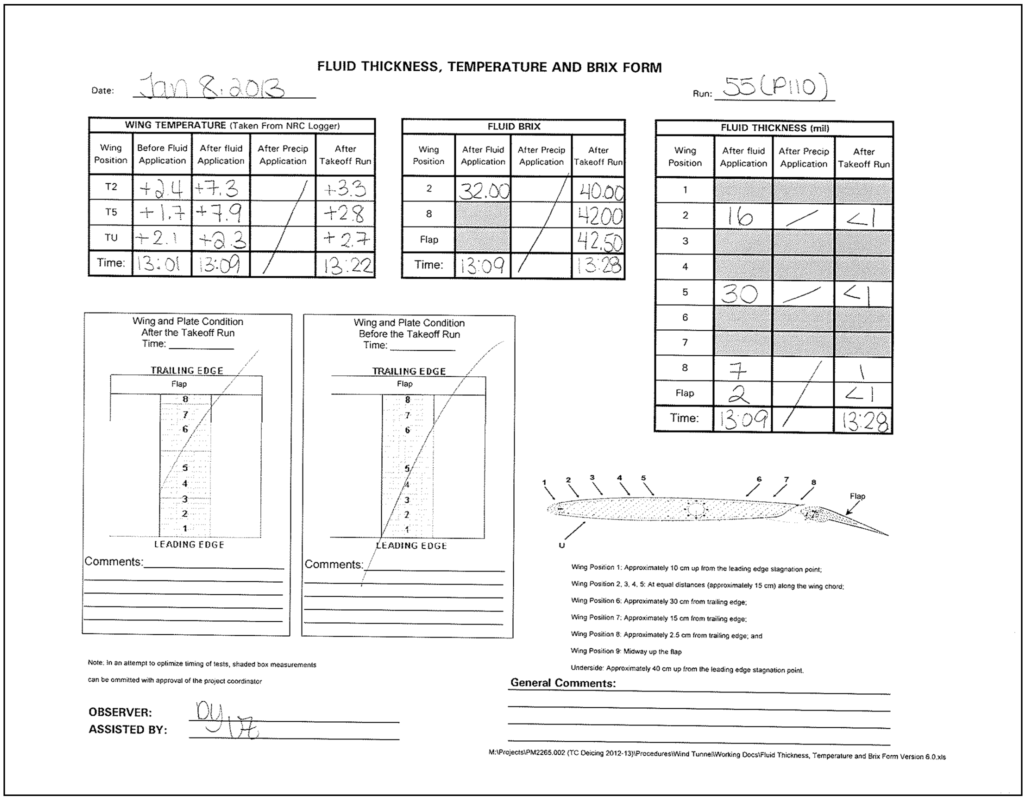
APPENDIX C

FLUID THICKNESS, TEMPERATURE, AND BRIX DATA FORMS



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 8.2013

Run: 55(P110)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+2.4	+7.3	/	+3.3
T5	+1.7	+7.9	/	+2.8
TU	+2.1	+2.3	/	+2.7
Time:	13:01	13:09	/	13:22

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.00	/	40.00
8			42.00
Flap			42.50
Time:	13:09	/	13:28

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	16	—	<1
3			
4			
5	30	—	<1
6			
7			
8	7	/	1
Flap	2	/	<1
Time:	13:09	/	13:28

Wing and Plate Condition After the Takeoff Run Time: ______ (TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE)

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VT

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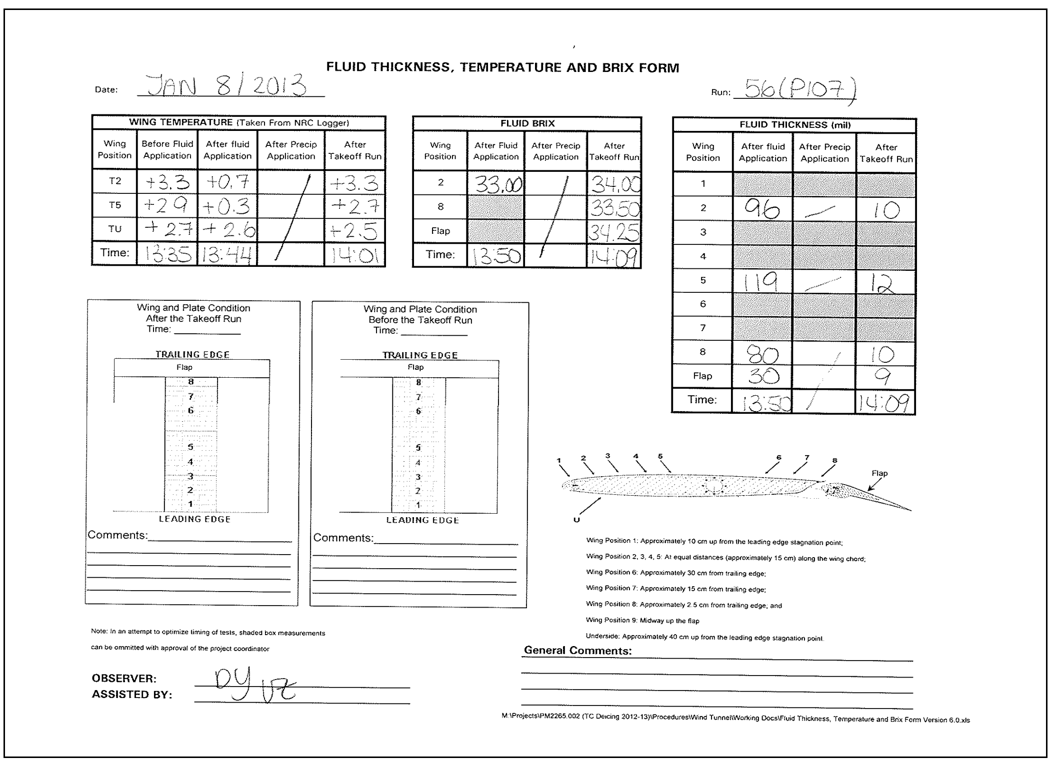
Figure C1: Test # 55



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 8/2013

Run: 56(P107)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+3.3	+0.7	/	+3.3
T5	+2.9	+0.3	/	+2.7
TU	+2.7	+2.6	/	+2.5
Time:	13:35	13:44	/	14:01

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.00	/	34.00
8			33.50
Flap			34.25
Time:	13:50	/	14:09

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	—	10
3			
4			
5	119	—	12
6			
7			
8	80	/	10
Flap	30	/	9
Time:	13:50	/	14:09

Wing and Plate Condition After the Takeoff Run Time: ______ (TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE)

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VT

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Figure C2: Test #56

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 8/2013

Run: 59 (P107)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+2.6	+2.3	/	+3.1
T5	+2.3	+1.7	/	+2.7
TU	+2.3	+1.9	/	+2.0
Time:	16:26	16:41	/	16:57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.50	/	33.75
8		/	33.25
Flap		/	33.50
Time:	16:41	/	16:57

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	—	6
3			
4			
5	127	—	3
6			
7			
8	80	/	8
Flap	35	/	11
Time:	16:41	/	16:57

Wing and Plate Condition After the Takeoff Run Time: ____

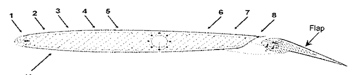
TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE

Comments: ____

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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Figure C3: Test #59

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 63 (P209)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+2.8	+2.5	+0.5	-0.3
T5	+2.2	+1.7	-0.3	-0.5
TU	+2.8	+2.7	+1.5	-1.3
Time:	00:48	00:55	01:26	01:46

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	16.00	36.00
8		24.00	31.25
Flap		2.00	29.25
Time:	1:00	1:29	01:55

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	2
3			
4			
5	158	158	6
6			
7			
8	112	127	7
Flap	35	2	4
Time:	00:58	01:28	01:54

Wing and Plate Condition After the Takeoff Run Time: ____

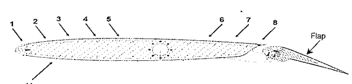
TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE

Comments: ____

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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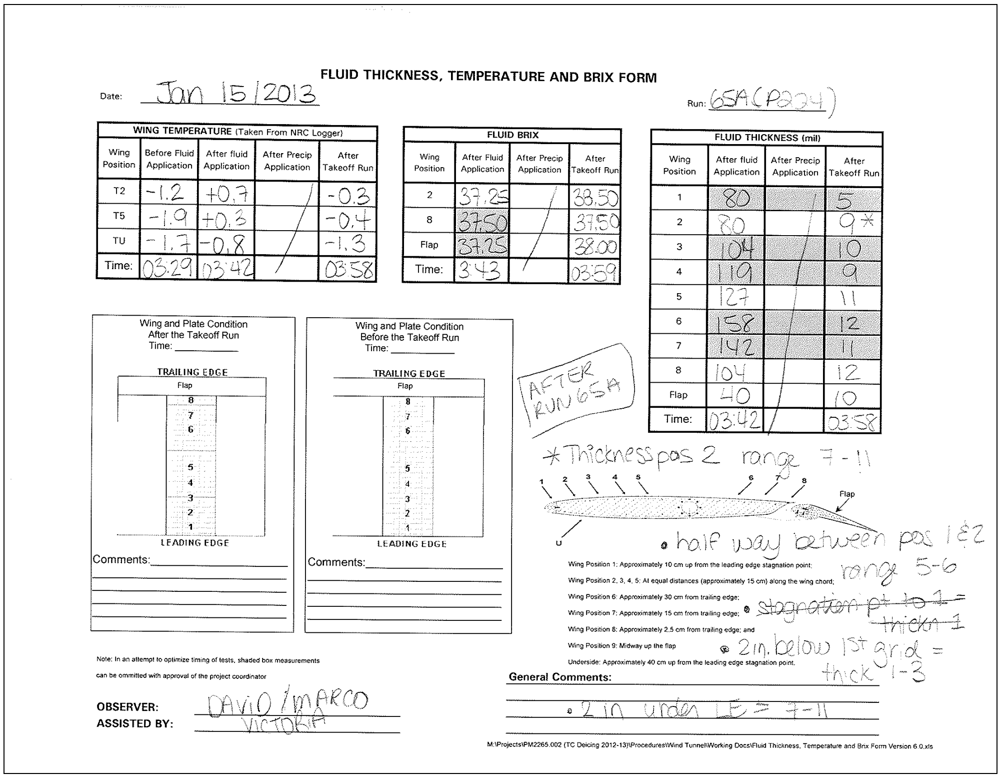
Figure C4: Test #63



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013 Run: 65A(P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.2	+0.7	/	-0.3
T5	-1.9	+0.3	/	-0.4
TU	-1.7	-0.8	/	-1.3
Time:	03:29	03:42	/	03:58

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	/	38.50
8	37.50	/	37.50
Flap	37.25	/	38.00
Time:	3:43	/	03:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	80	/	5
2	80	/	9*
3	104	/	10
4	119	/	9
5	127	/	11
6	158	/	12
7	142	/	11
8	104	/	12
Flap	40	/	10
Time:	03:42	/	03:58

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run Time: ______

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

Comments: ______

AFTER RUN 65A

*Thickness pos 2 range 7-11

1 2 3 4 5 6 7 8 Flap U

• half way between pos 1 & 2 range 5-6

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.

• ~~stagnation pt to 1 = thickn 1~~

• 2 in. below 1st grid = thick 1-3

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

General Comments:
• 2 in under LE = 7-11

OBSERVER: DAVID / MARCO
ASSISTED BY: VICTORIA

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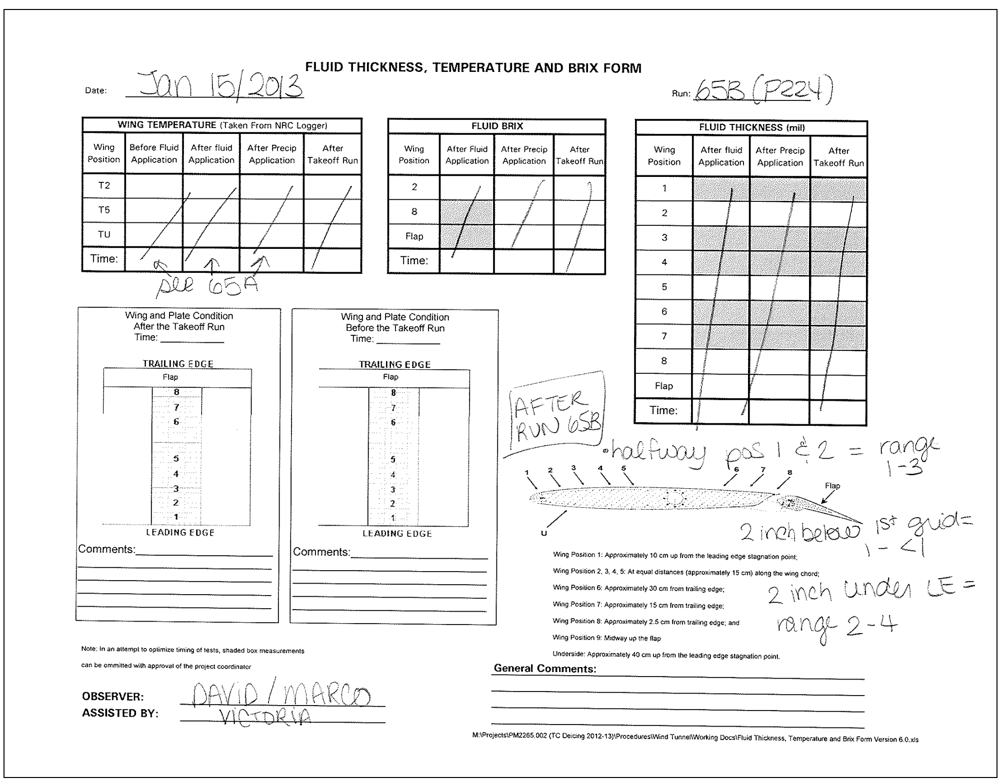
Figure C5: Test #65A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013 Run: 65B(P224)

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

see 65A

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:	/	/	/

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run Time: ______

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

Comments: ______

AFTER RUN 65B

• halfway pos 1 & 2 = range 1-3

1 2 3 4 5 6 7 8 Flap U

2 inch below 1st grid = 1 - <1

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.

2 inch under LE = range 2-4

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

General Comments:

OBSERVER: DAVID / MARCO
ASSISTED BY: VICTORIA

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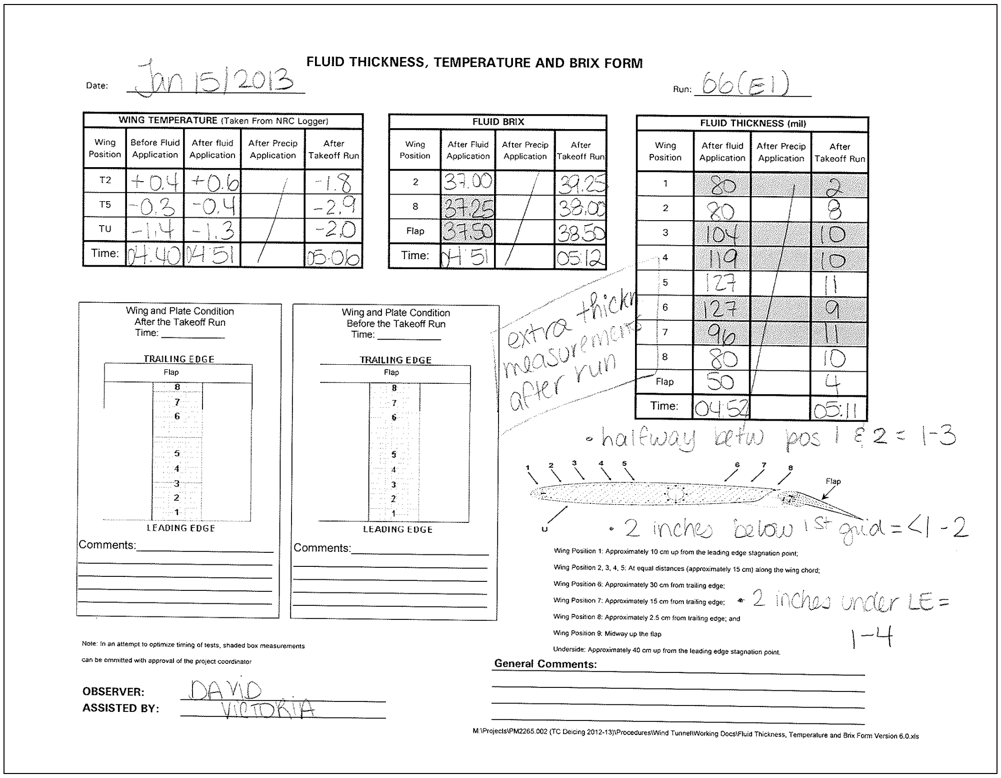
Figure C6: Test #65B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 66(E1)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+0.4	+0.6	/	-1.8
T5	-0.3	-0.4	/	-2.9
TU	-1.4	-1.3	/	-2.0
Time:	04:40	04:51	/	05:06

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	/	39.25
8	37.25	/	38.00
Flap	37.50	/	38.50
Time:	04:51	/	05:12

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	80	/	2
2	80	/	8
3	104	/	10
4	119	/	10
5	127	/	11
6	127	/	9
7	96	/	11
8	80	/	10
Flap	50	/	4
Time:	04:52		05:11

extra thickn measurements after run

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments: ____

Wing and Plate Condition Before the Takeoff Run Time: ____

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

Comments: ____

• halfway betw pos 1 & 2 = 1-3

1 2 3 4 5 6 7 8 Flap U

• 2 inches below 1st grid = <1-2

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.

• 2 inches under LE = 1-4

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

General Comments: ____

OBSERVER: DAVID
ASSISTED BY: VICTORIA

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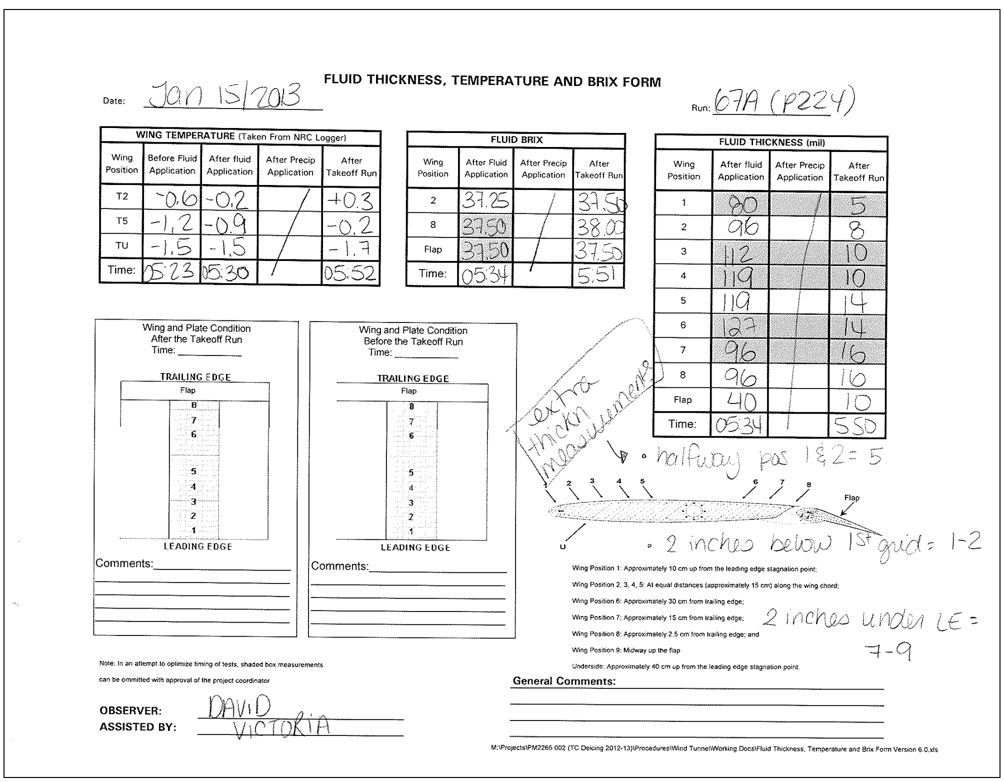
Figure C7: Test #66



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 67A (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.6	-0.2	/	+0.3
T5	-1.2	-0.9	/	-0.2
TU	-1.5	-1.5	/	-1.7
Time:	05:23	05:30	/	05:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	/	37.50
8	37.50	/	38.00
Flap	37.50	/	37.50
Time:	05:34		5:51

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	80	/	5
2	96	/	8
3	112	/	10
4	119	/	10
5	119	/	14
6	127	/	14
7	96	/	16
8	96	/	16
Flap	40	/	10
Time:	05:34	/	550

extra thickn measurements

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments: ____

Wing and Plate Condition Before the Takeoff Run Time: ____

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

Comments: ____

• halfway pos 1 & 2 = 5

1 2 3 4 5 6 7 8 Flap U

• 2 inches below 1st grid = 1-2

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.

2 inches under LE = 7-9

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

General Comments: ____

OBSERVER: DAVID
ASSISTED BY: VICTORIA

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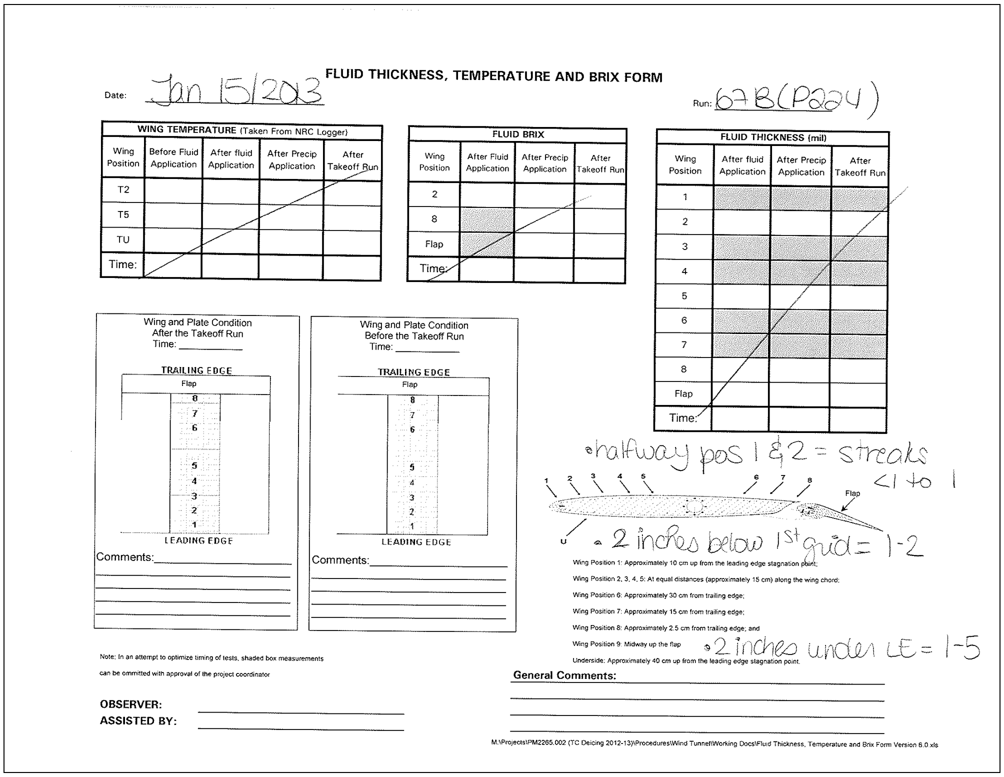
Figure C8: Test #67A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 67B(P224)

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:			

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before the Takeoff Run
Time: ________

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

Comments:

- halfway pos 1 & 2 = streaks <1 to 1

1 2 3 4 5 6 7 8 Flap U

- 2 inches below 1st grid = 1-2

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.

- 2 inches under LE = 1-5

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

General Comments:

OBSERVER:
ASSISTED BY:

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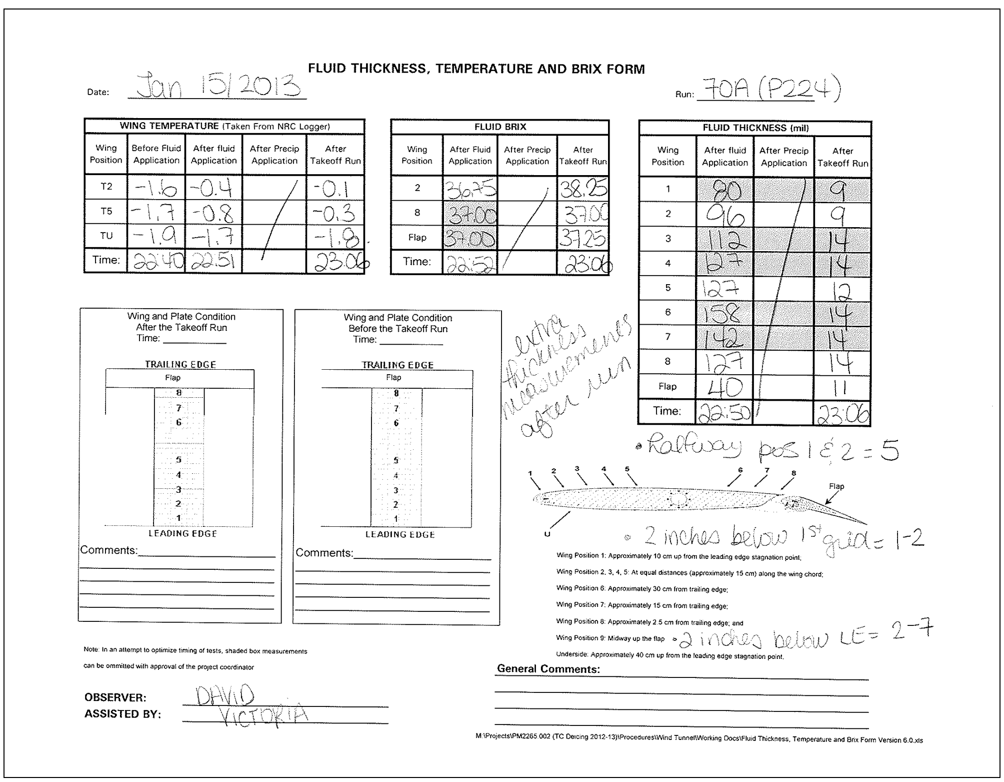
Figure C9: Test #67B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 70A (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.6	-0.4		-0.1
T5	-1.7	-0.8		-0.3
TU	-1.9	-1.7		-1.8
Time:	22:40	22:51		23:06

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75		38.25
8	37.00		37.00
Flap	37.00		37.25
Time:	22:52		23:06

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	80		9
2	96		9
3	112		14
4	127		14
5	127		12
6	158		14
7	142		14
8	127		14
Flap	40		11
Time:	22:50		23:06

extra thickness measurements after run

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before the Takeoff Run
Time: ________

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

Comments:

- halfway pos 1 & 2 = 5

1 2 3 4 5 6 7 8 Flap U

- 2 inches below 1st grid = 1-2

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.

- 2 inches below LE = 2-7

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

General Comments:

OBSERVER: DAVID
ASSISTED BY: VICTORIA

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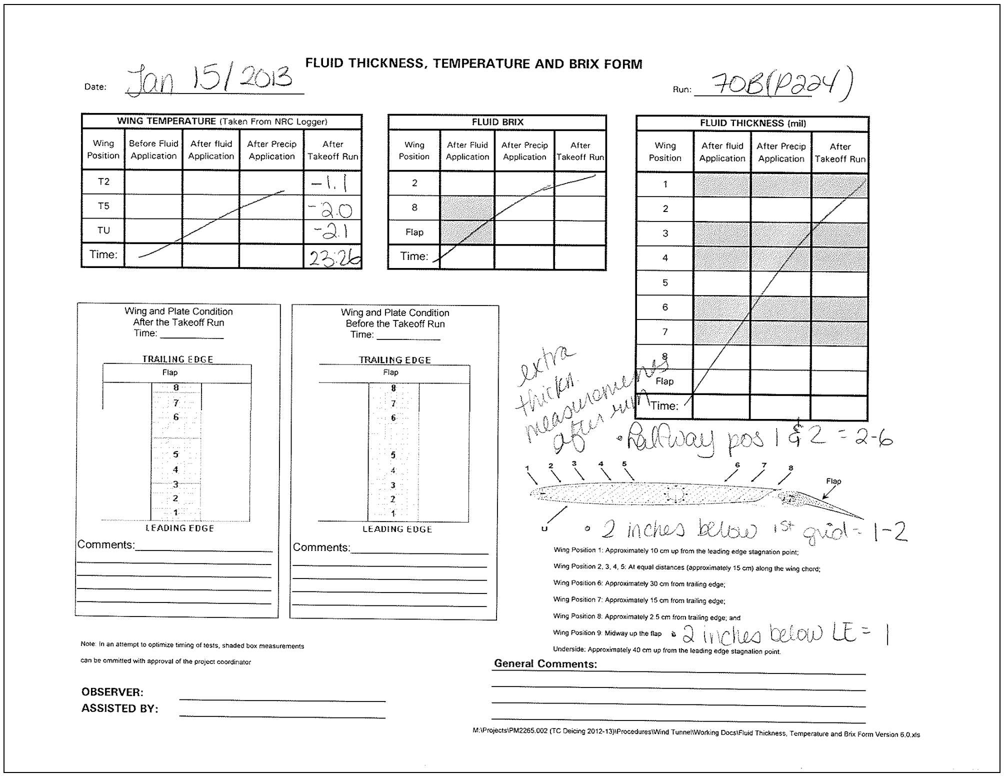
Figure C10: Test #70A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 70B(P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2				-1.1
T5				-2.0
TU				-2.1
Time:				23:26

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:			

extra thickn measurements after run

• halfway pos 1 & 2 = 2-6

• 2 inches below 1st grid = 1-2

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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.

• 2 inches below LE = 1

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

General Comments: ______

OBSERVER: ______
ASSISTED BY: ______

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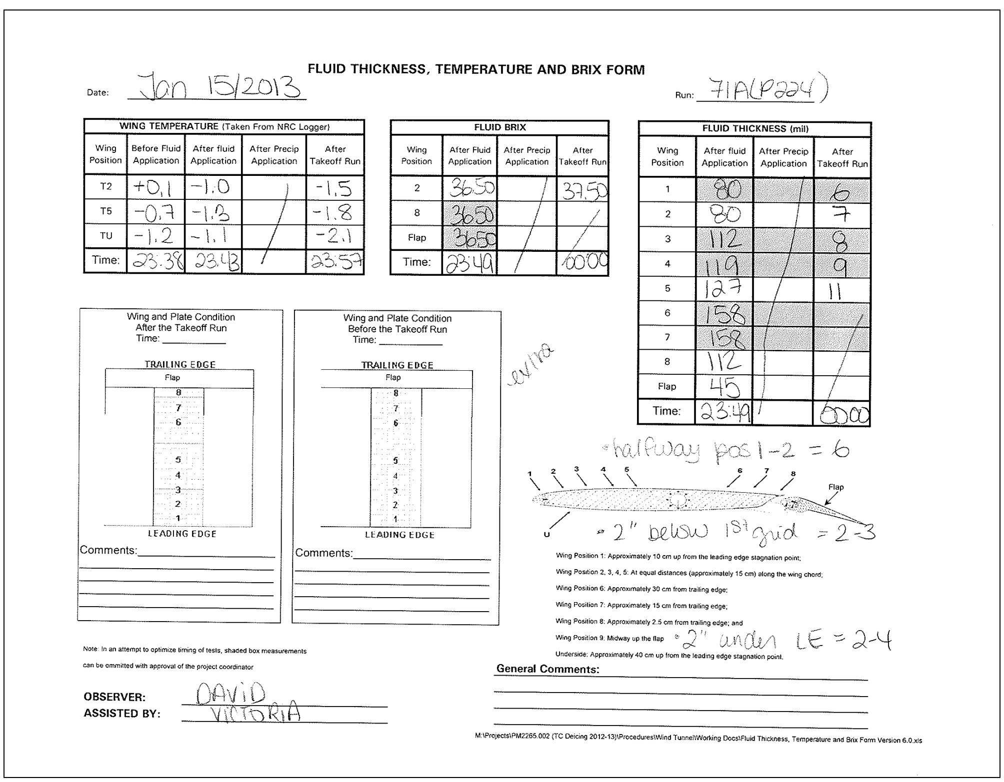
Figure C11: Test #70B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 71A(P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+0.1	-1.0		-1.5
T5	-0.7	-1.3		-1.8
TU	-1.2	-1.1		-2.1
Time:	23:38	23:43		23:57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50		37.50
8	36.50		
Flap	36.50		
Time:	23:49		00:00

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	80		6
2	80		7
3	112		8
4	119		9
5	127		11
6	158		
7	158		
8	112		
Flap	45		
Time:	23:49		0000

extra

• halfway pos 1-2 = 6

• 2" below 1st grid = 2-3

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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.

• 2" under LE = 2-4

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

General Comments: ______

OBSERVER: DAVID
ASSISTED BY: VICTORIA

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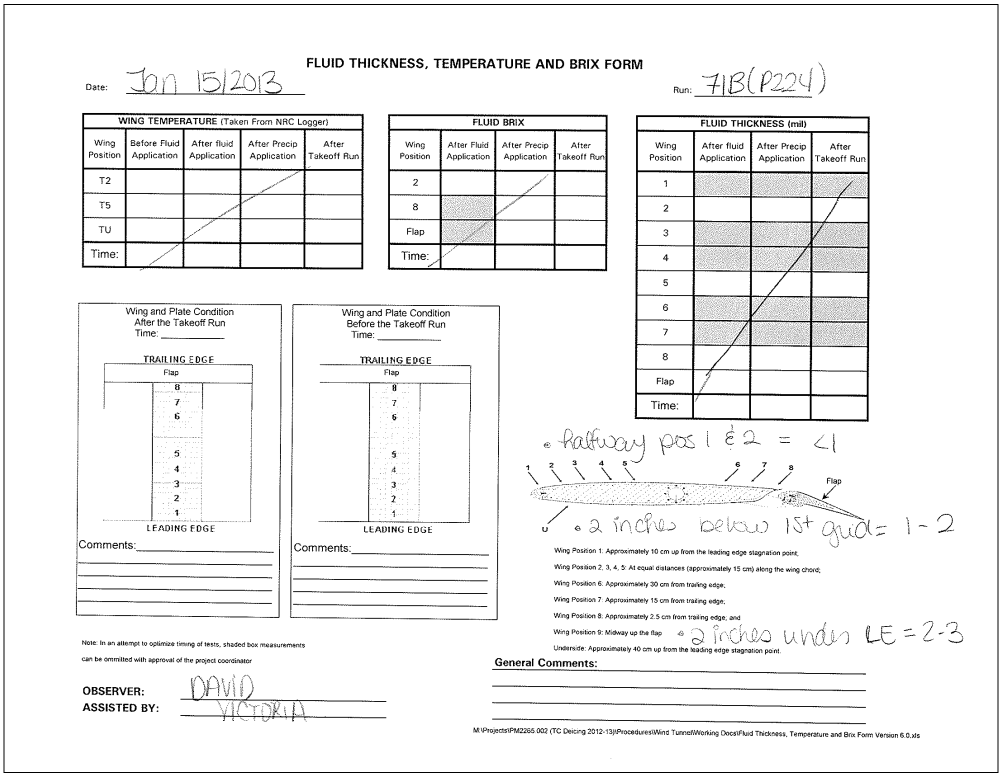
Figure C12: Test #71A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 71B(P224)

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:			

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before the Takeoff Run
Time: ________

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

Comments:

• halfway pos 1 & 2 = <1

1 2 3 4 5 6 7 8 Flap U

• 2 inches below 1st grid = 1-2

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 • 2 inches under LE = 2-3
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: DAVID
ASSISTED BY: VICTORIA

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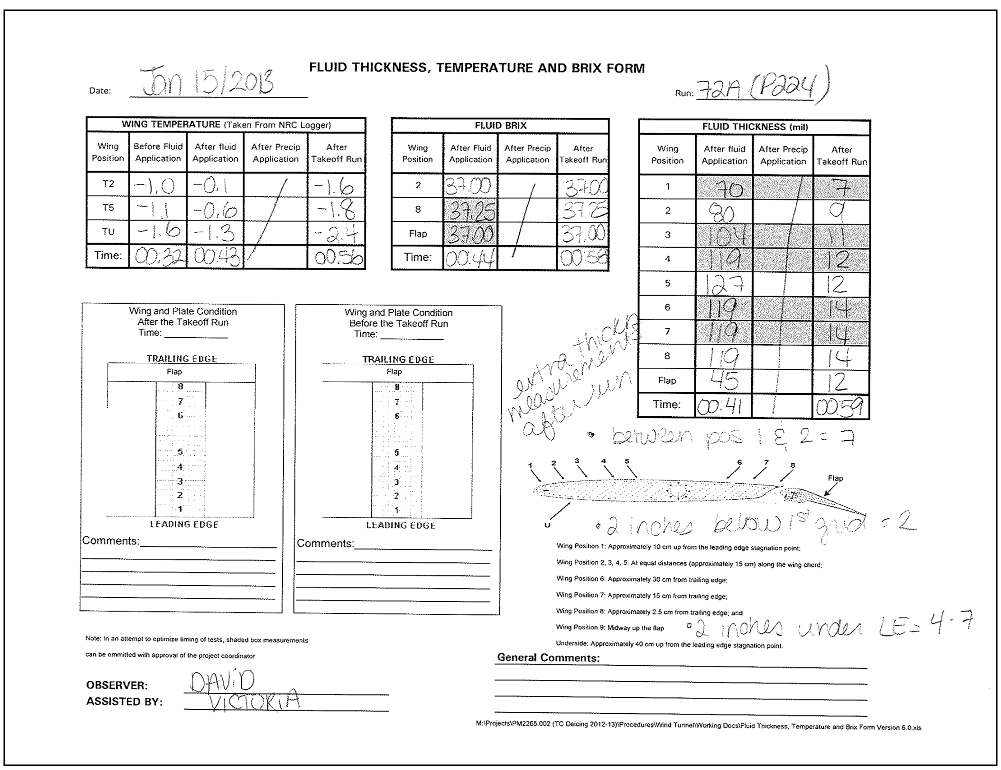
Figure C13: Test #71B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 72A (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.0	-0.1		-1.6
T5	-1.1	-0.6		-1.8
TU	-1.6	-1.3		-2.4
Time:	00:32	00:43		00:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00		37.00
8	37.25		37.25
Flap	37.00		37.00
Time:	00:44		00:58

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	70		7
2	80		9
3	104		11
4	119		12
5	127		12
6	119		14
7	119		14
8	119		14
Flap	45		12
Time:	00:41		00:59

extra thick measurements after run

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before the Takeoff Run
Time: ________

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

Comments:

• between pos 1 & 2 = 7

1 2 3 4 5 6 7 8 Flap U

• 2 inches below 1st grid = 2

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 • 2 inches under LE = 4-7
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: DAVID
ASSISTED BY: VICTORIA

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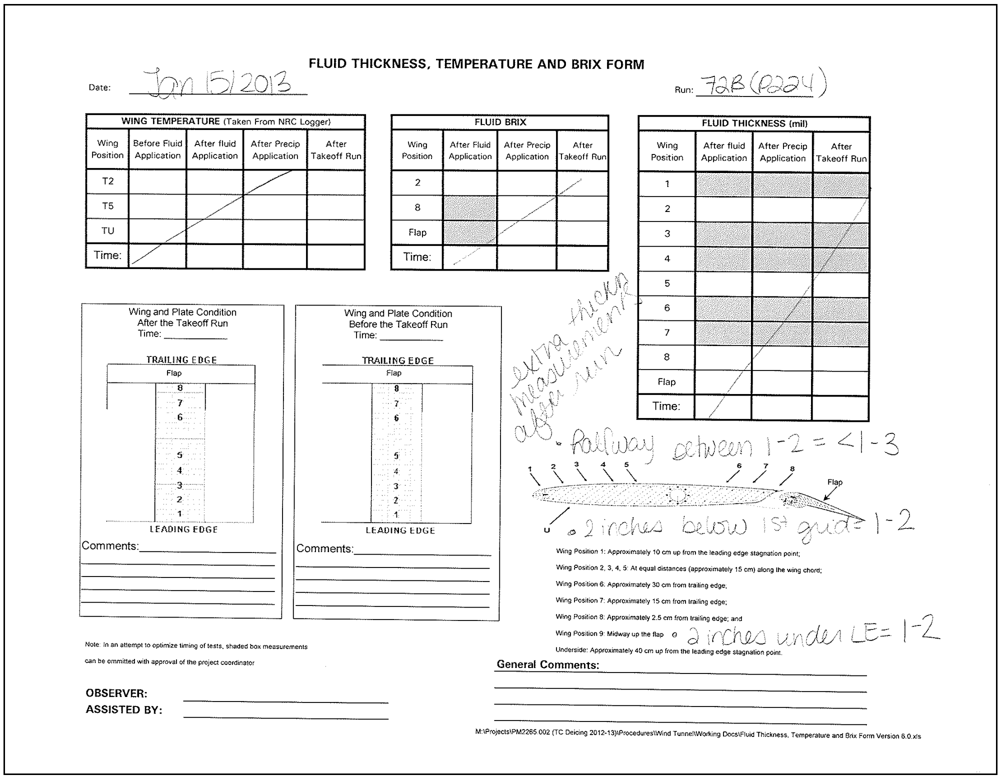
Figure C14: Test #72A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 15/2013

Run: 72B (P224)

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:			

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run
Time: ______

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

Comments: ______

extra thickness measurement after run
- Halfway between 1-2 = <1-3

1 2 3 4 5 6 7 8 Flap U

- 2 inches below 1st grid = 1-2

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
- 2 inches under LE = 1-2
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: ______
ASSISTED BY: ______

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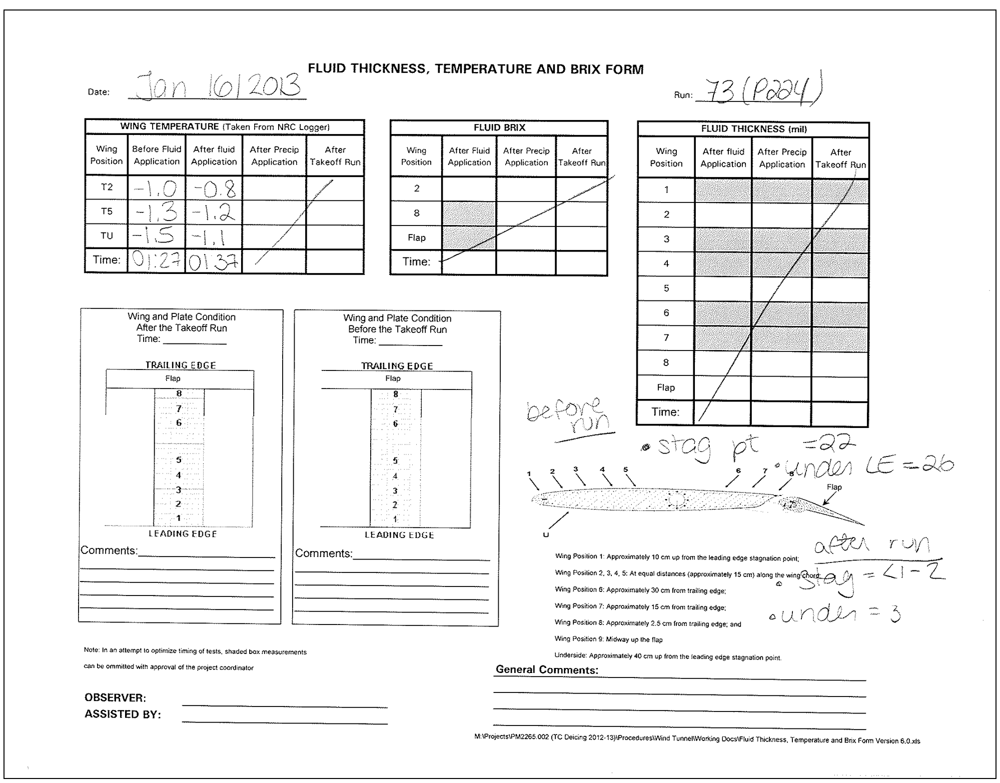
Figure C15: Test #72B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 16/2013

Run: 73 (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.0	-0.8		
T5	-1.3	-1.2		
TU	-1.5	-1.1		
Time:	01:27	01:37		

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:			

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run
Time: ______

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

Comments: ______

before run
- stag pt = 22
- under LE = 26

1 2 3 4 5 6 7 8 Flap U

after run
- stag = <1-2
- under = 3

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: ______
ASSISTED BY: ______

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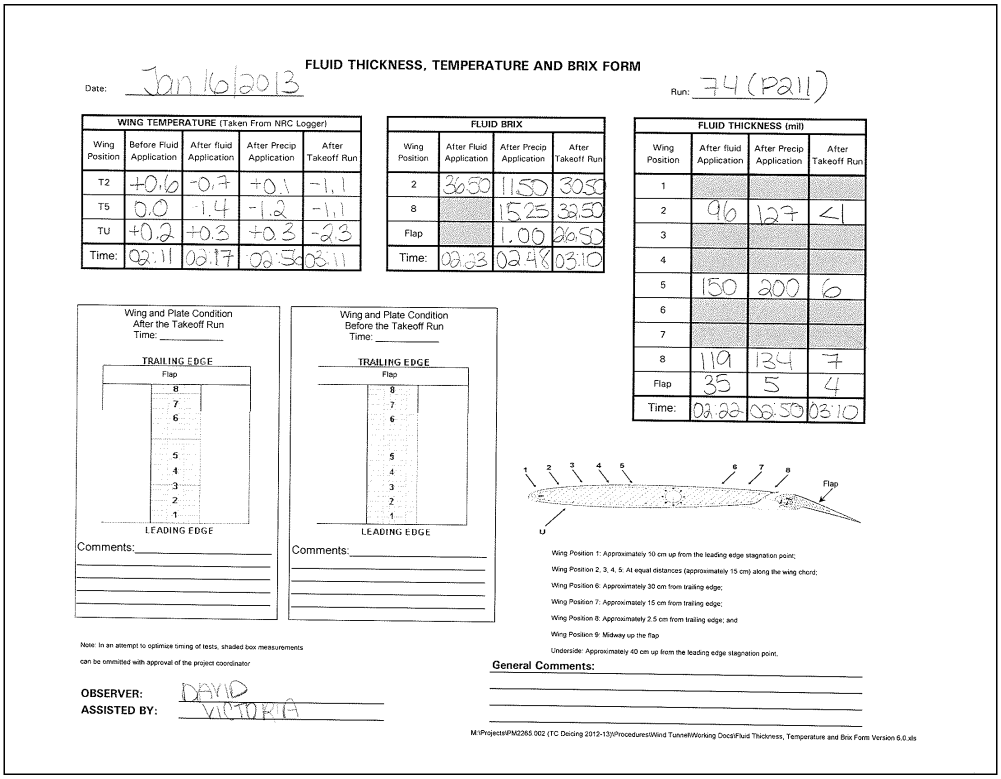
Figure C16: Test #73



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 16/2013

Run: 74 (P211)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+0.6	-0.7	+0.1	-1.1
T5	0.0	-1.4	-1.2	-1.1
TU	+0.2	+0.3	+0.3	-2.3
Time:	02:11	02:17	02:36	03:11

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	11.50	30.50
8		15.25	32.50
Flap		1.00	26.50
Time:	02:23	02:48	03:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	<1
3			
4			
5	150	200	6
6			
7			
8	119	134	7
Flap	35	5	4
Time:	02:22	02:50	03:10

Wing and Plate Condition After the Takeoff Run
Time: ____________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ____________

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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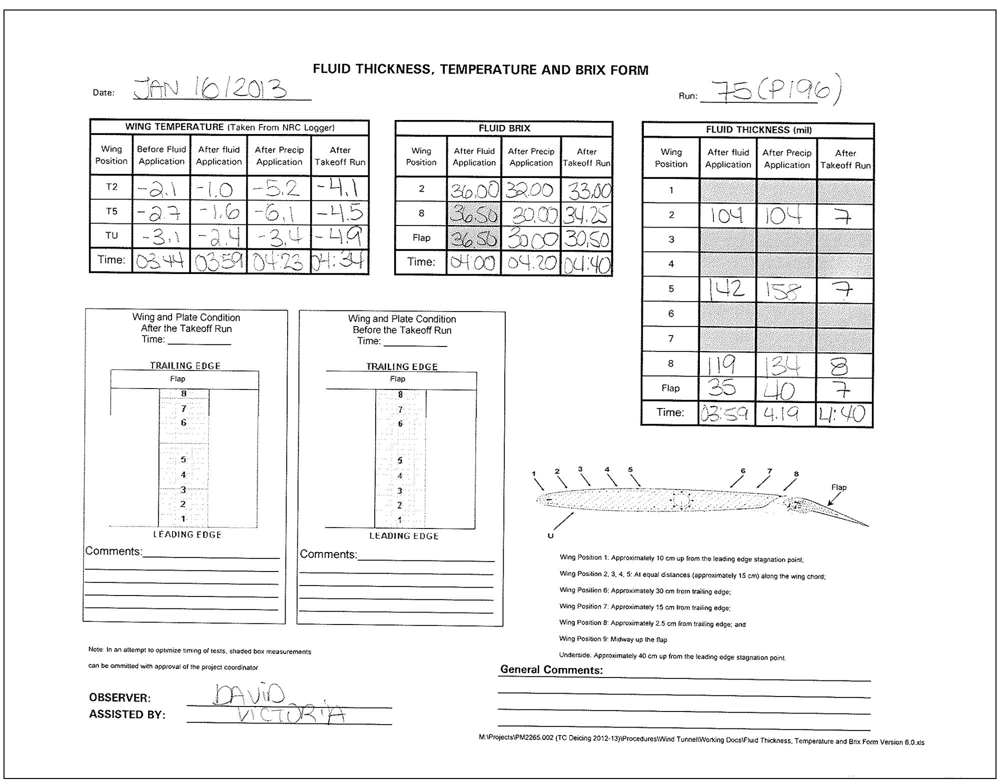
Figure C17: Test #74



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 16/2013

Run: 75 (P196)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-2.1	-1.0	-5.2	-4.1
T5	-2.7	-1.6	-6.1	-4.5
TU	-3.1	-2.4	-3.4	-4.9
Time:	03:44	03:59	04:23	04:34

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.00	32.00	33.00
8	36.50	30.00	34.25
Flap	36.50	30.00	30.50
Time:	04:00	04:20	04:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	104	7
3			
4			
5	142	158	7
6			
7			
8	119	134	8
Flap	35	40	7
Time:	03:59	4.19	4:40

Wing and Plate Condition After the Takeoff Run
Time: ____________
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ____________

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C18: Test #75

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 16/2013 Run: 76(P183)

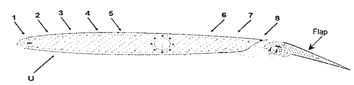
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	/	-1.0	-6.7	-2.6
T5	/	-1.5	-7.2	-2.5
TU	/	-2.4	-4.3	-4.5
Time:	/	0504	0555	06:11

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	16.00	23.75
8		16.00	28.00
Flap		16.00	24.75
Time:	0505	0551	06:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	142	4
3			
4			
5	142	250	7
6			
7			
8	112	158	9
Flap	35	35	6
Time:	05:04	05:51	06:10

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C19: Test #76

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 16/2013 Run: 79A(P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+1.1	+1.4	/	+1.4
T5	+0.4	+0.8	/	+0.8
TU	+0.5	+0.6	/	+0.9
Time:	22:52	23:05	/	23:15

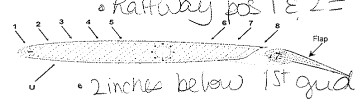
FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	/	37.00
8	37.25	/	37.00
Flap	37.00	/	37.25
Time:	23:05	/	23:25

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1	70	/	9
2	80	/	10
3	104	/	10
4	112	/	9
5	119	/	9
6	134	/	12
7	158	/	16
8	127	/	16
Flap	50	/	14
Time:	23:03	/	23:23

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ______

Wing and Plate Condition Before the Takeoff Run
Time: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ______

extra thickn measurements
• Halfway pos 1 & 2 = 7



• 2 inches below 1st grid = 3

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 • 2 inches below LE = 4
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: DAVID
ASSISTED BY: VICTORIA

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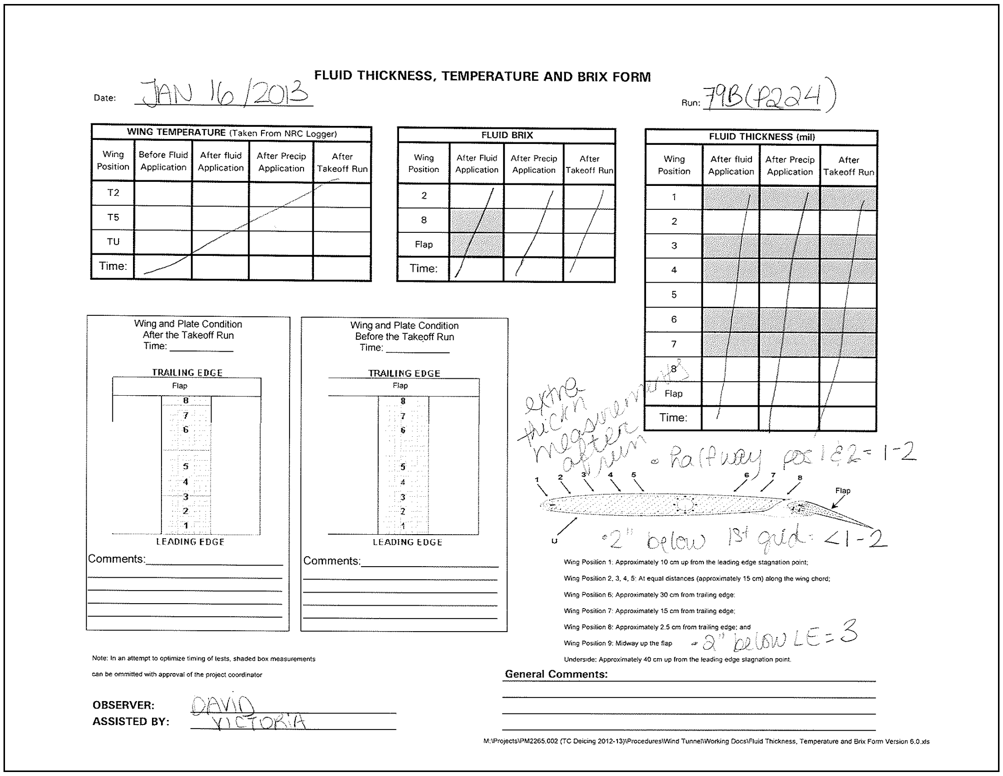
Figure C20: Test #79A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 16/2013

Run: 79B(P224)

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:			

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before the Takeoff Run Time: ____

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

Comments:

extra thickn measurements after run

- halfway pos 1 & 2 = 1-2
- 2" below 1st grid = <1-2

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 - 2" below LE = 3

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: DAVID

ASSISTED BY: VICTORIA

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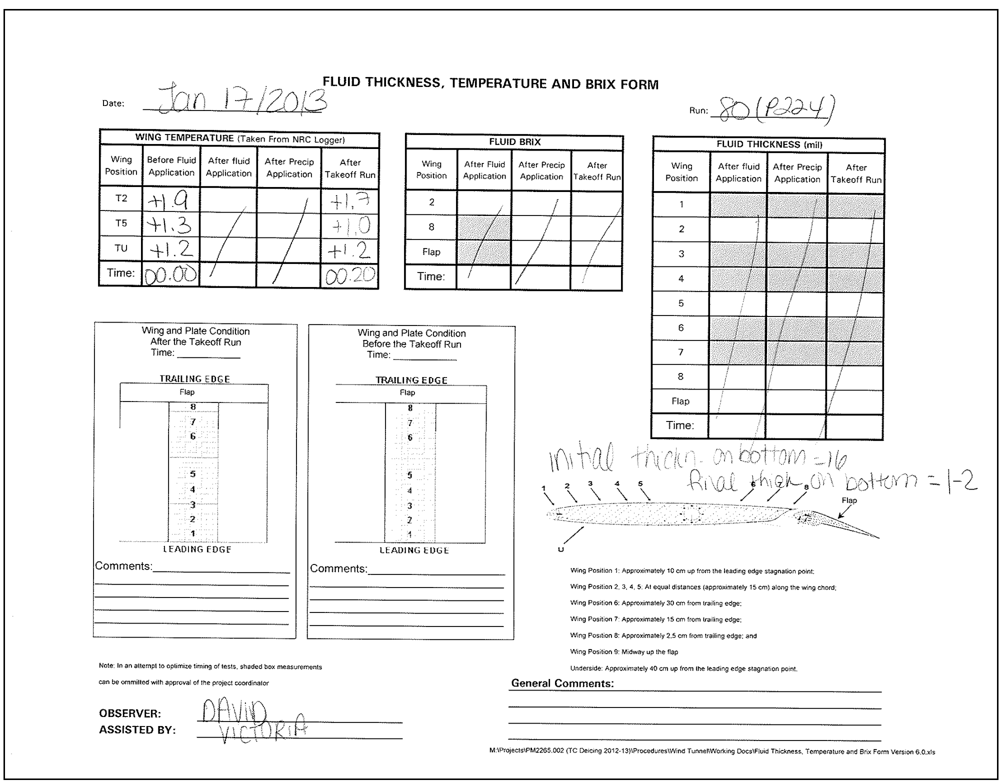
Figure C21: Test #79B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17/2013

Run: 80(P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	+1.9			+1.7
T5	+1.3			+1.0
TU	+1.2			+1.2
Time:	00.00			00.20

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:			

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before the Takeoff Run Time: ____

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

Comments:

initial thickn. on bottom = 16

final thickn. on bottom = 1-2

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: DAVID

ASSISTED BY: VICTORIA

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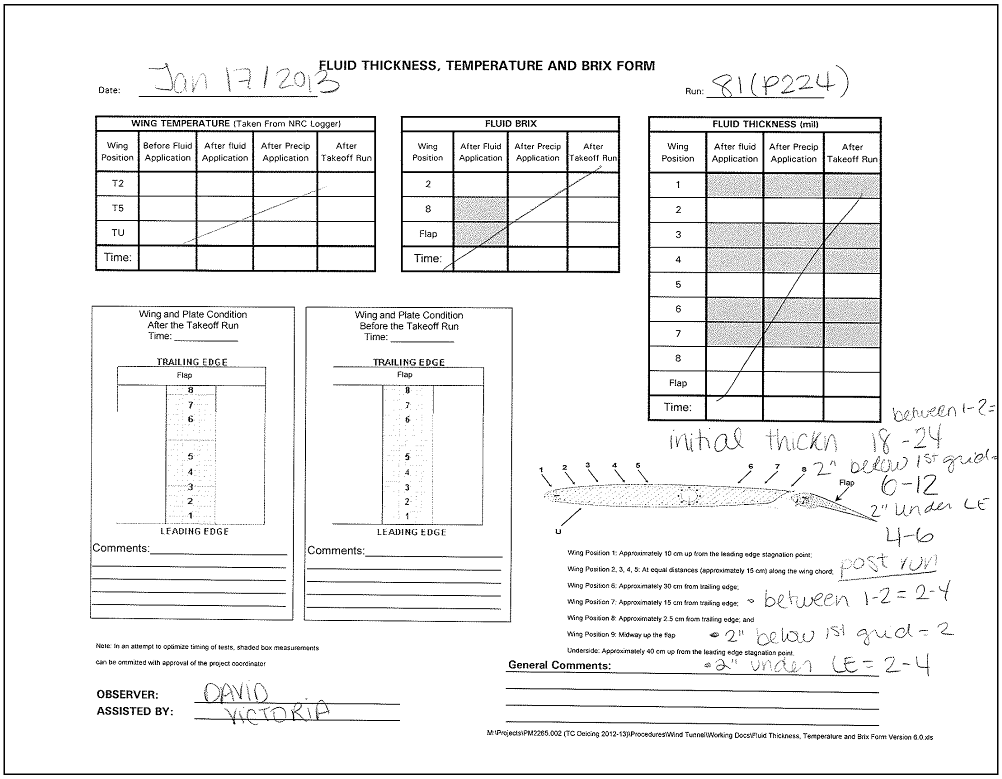
Figure C22: Test #80



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17/2013

Run: 81(P224)

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:			

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run Time: ______

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

Comments: ______

initial thickn between 1-2 = 18-24
2" below 1st guide = 6-12
2" under LE 4-6

post run
• between 1-2 = 2-4
• 2" below 1st guide = 2
• 2" under LE = 2-4

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: DAVID
ASSISTED BY: VICTORIA

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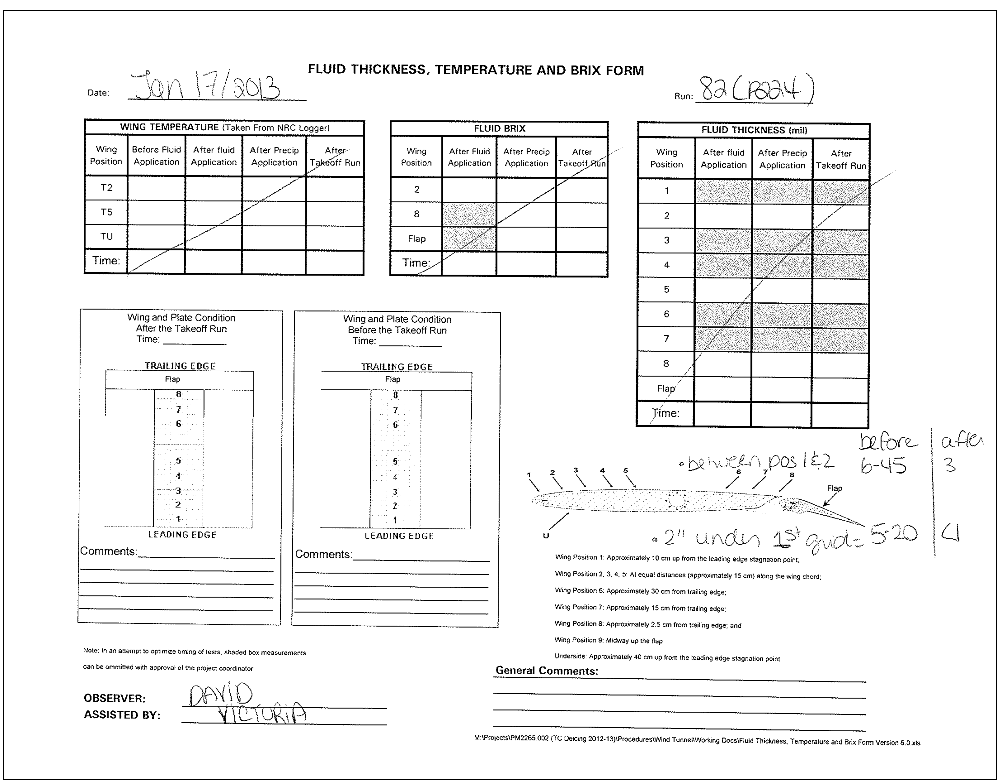
Figure C23: Test #81



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17/2013

Run: 82(P224)

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:			

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before the Takeoff Run Time: ______

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

Comments: ______

	before	after
• between pos 1&2	6-45	3
• 2" under 1st guide	5-20	4

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: DAVID
ASSISTED BY: VICTORIA

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Figure C24: Test #82

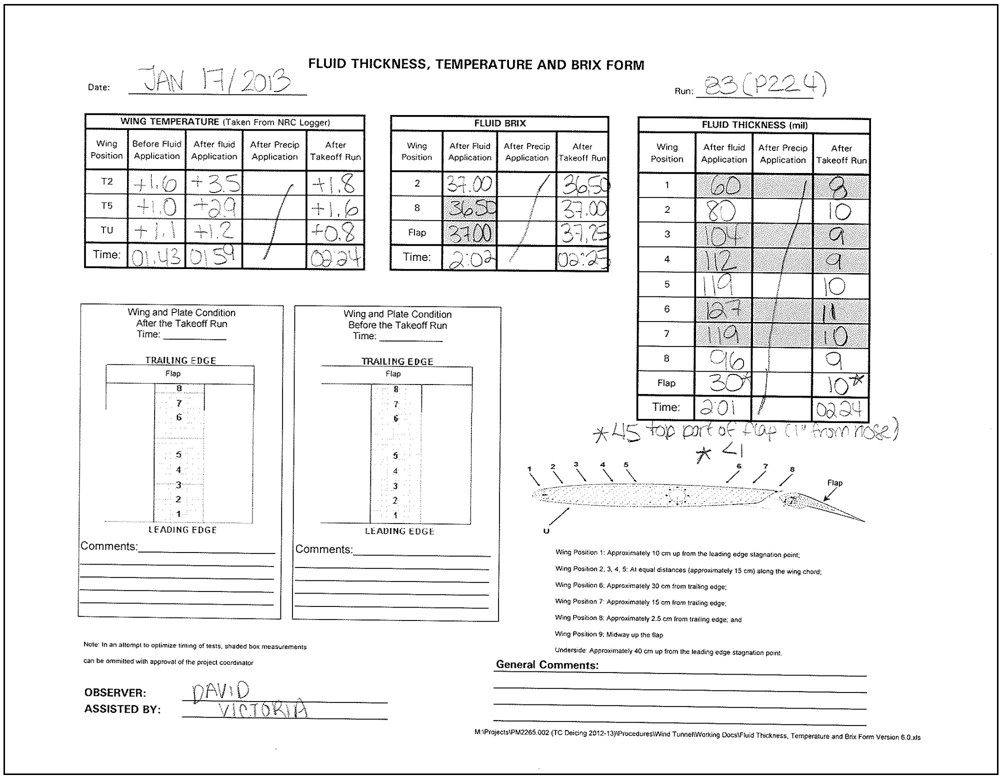


Figure C25: Test #83

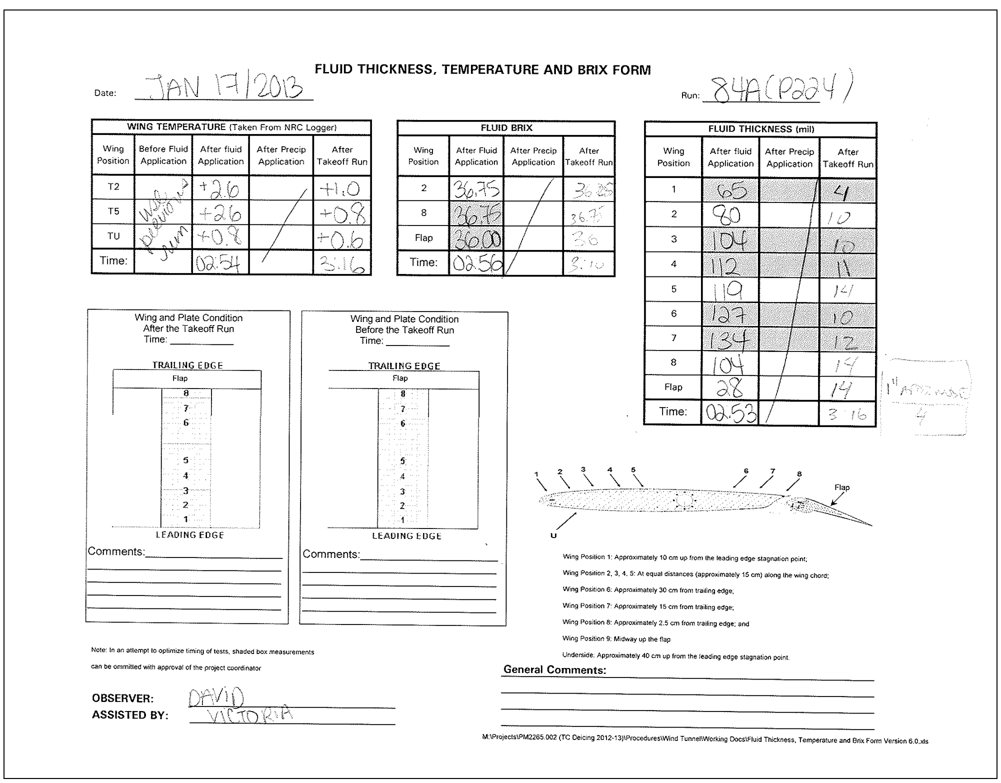
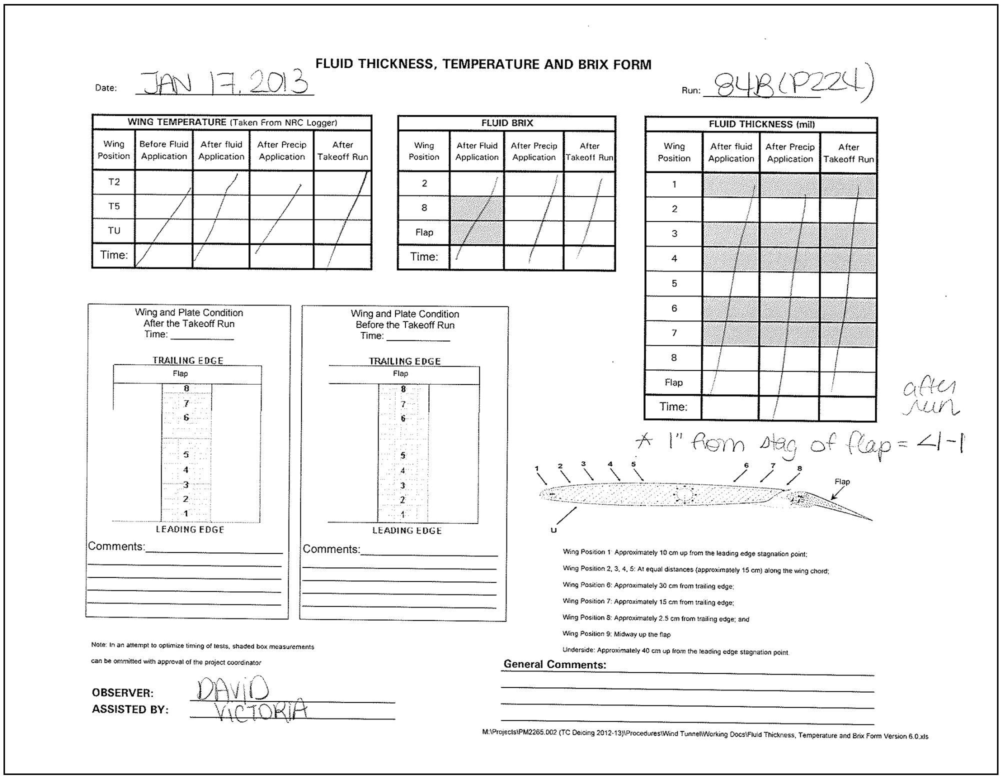


Figure C26: Test #84A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 17, 2013

Run: 84B (P224)

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:			

after run

* 1" from stag of flap = <1-1

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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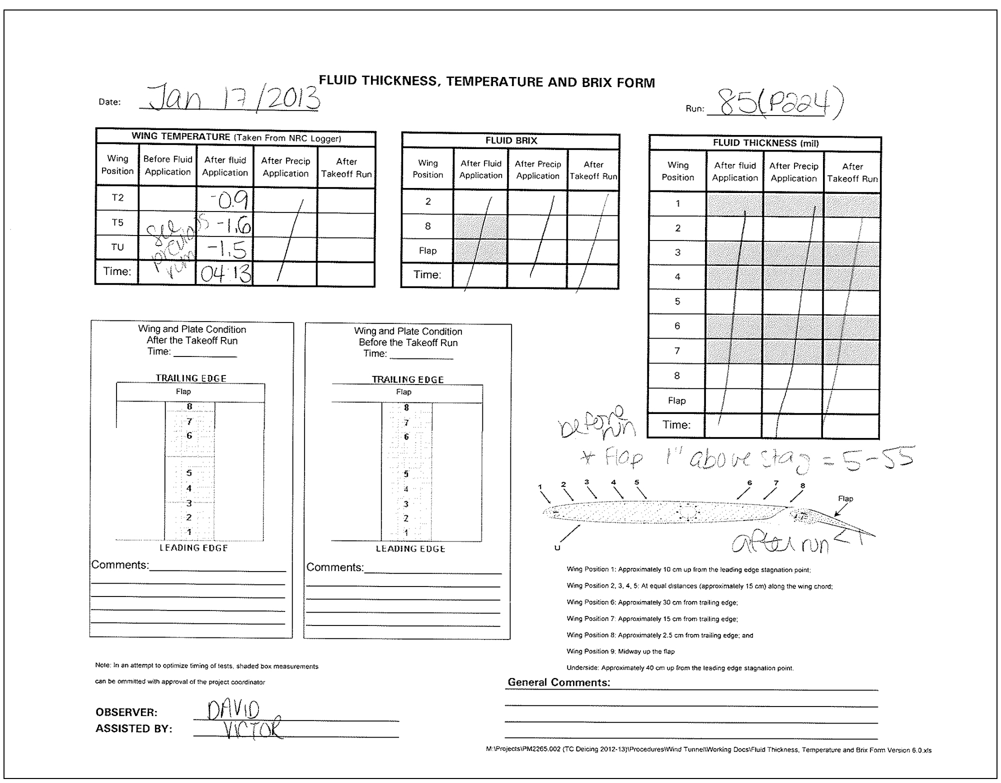
Figure C27: Test #84B



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17/2013

Run: 85 (P224)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous run	-0.9		
T5		-1.6		
TU		-1.5		
Time:		04:13		

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:			

before run

* Flap 1" above stag = 5-55

after run <1

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTOR

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Figure C28: Test #85

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17, 2013

Run: 86(P196)

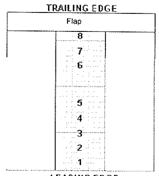
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-1.8	-1.7	-10.5	-6.7
T5	-2.6	-2.3	-9.8	-7.0
TU	-2.3	-3.1	-4.1	-6.3
Time:	04:41	04:48	05.12	05:21

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	23.00	25.50
8		22.00	32.00
Flap		20.00	32.00
Time:	04:5	05:10	05:30

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	142	6
3			
4			
5	158	200	6
6			
7			
8	119	158	6
Flap	35	30	6
Time:	04:52	05:09	05:29

Wing and Plate Condition
After the Takeoff Run
Time: ________

TRAILING EDGE

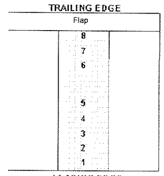


LEADING EDGE

Comments: ________

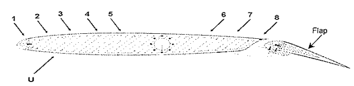
Wing and Plate Condition
Before the Takeoff Run
Time: ________

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: DAVID
ASSISTED BY: VICTORIA

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Figure C29: Test #86

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 17, 2013

Run: 87 (P214)

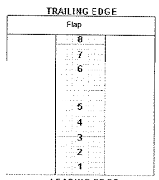
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.3	-4.1	-10.1	-8.8
T5	-6.6	-4.4	-10.0	-9.4
TU	-6.7	-6.5	-7.6	-9.1
Time:	05:37	05:48	06:20	06:31

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	23.00	30.50
8		25.00	32.00
Flap		20.00	29.00
Time:	05:51	06:14	06:35

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	134	134	10
3			
4			
5	158	200	14
6			
7			
8	112	142	14
Flap	40	65	14
Time:	05:52	6.13	06:35

Wing and Plate Condition
After the Takeoff Run
Time: ________

TRAILING EDGE

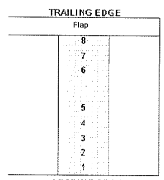


LEADING EDGE

Comments: ________

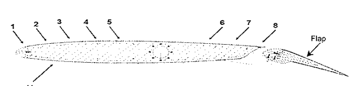
Wing and Plate Condition
Before the Takeoff Run
Time: ________

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: DAVID
ASSISTED BY: VICTORIA

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Figure C30: Test #87

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17 2013

Run: 90(P011)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2		-11.1	-13.2	-13.1
T5	N/A	-11.3	-13.1	-12.6
TU		-13.9	-13.9	-15.8
Time:		22:54	23:25	23:41

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	30.00	33.50
8		31.50	31.00
Flap		25.50	31.75
Time:	22:53	23:25	23:41

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	119	6
3			
4			
5	119	158	6
6			
7			
8	96	127	8
Flap	35	50	10
Time:	22:53	23:20	23:41

Wing and Plate Condition After the Takeoff Run
Time: ____

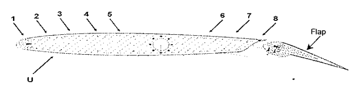
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments: ____

Wing and Plate Condition Before 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: MARCO
ASSISTED BY: VICTORIA

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Figure C31: Test #90

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 17, 2013

Run: 91(P012)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.7	-12.1	-14.1	-16.7
T5	-11.8	-12.2	-14.2	-17.9
TU	-15.0	-14.1	-13.3	-17.3
Time:	23:45	00:01	00:35	00:43

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	32.50	32.50
8		29.50	32.50
Flap		27.50	33.25
Time:	00:00	00:30	00:55

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	96	6
3			
4			
5	119	158	6
6			
7			
8	96	119	9
Flap	35	40	7
Time:	00:00	00:30	00:55

Wing and Plate Condition After the Takeoff Run
Time: ____

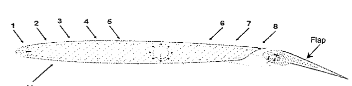
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments: ____

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C32: Test #91

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 18, 2013

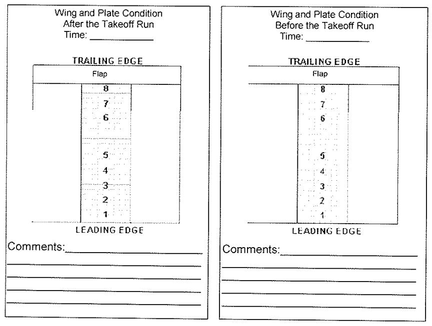
Run: 92 (P032)

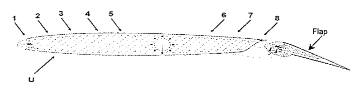
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-12.0	-15.3	-14.9
T5		-12.3	-15.2	-14.3
TU		-14.4	-14.8	-16.7
Time:		01:13	01:26	01:40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	35.00	34.00
8		35.25	33.50
Flap		29.00	32.50
Time:	01:13	01:25	01:39

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	96	7
3			
4			
5	127	150	6
6			
7			
8	104	119	10
Flap	35	slush*	9
Time:	01:13	01:25	01:39

*24





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: DAVID

ASSISTED BY: VICTORIA

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Figure C33: Test #92

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

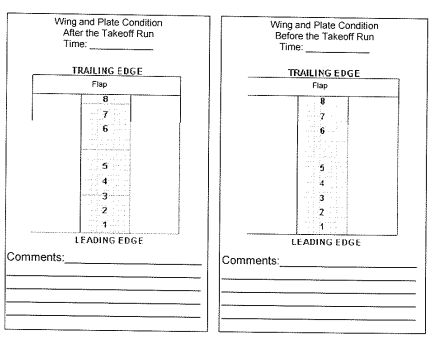
Date: Jan 18, 2013

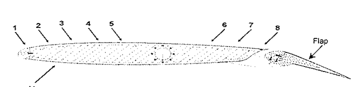
Run: 93 (P031)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-13.3	-13.0	-14.9	-17.5
T5	-12.9	-13.1	-15.0	-18.3
TU	-14.8	-14.4	-12.9	-18.1
Time:	01:52	01:57	02:16	02:22

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	29.50	34.50
8		32.00	31.50
Flap		29.00	31.00
Time:	02:02	02:13	02:34

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	96	5
3			
4			
5	142	158	6
6			
7			
8	96	134	3
Flap	30	24	7
Time:	02:02	02:13	02:31





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: DAVID

ASSISTED BY: VICTORIA

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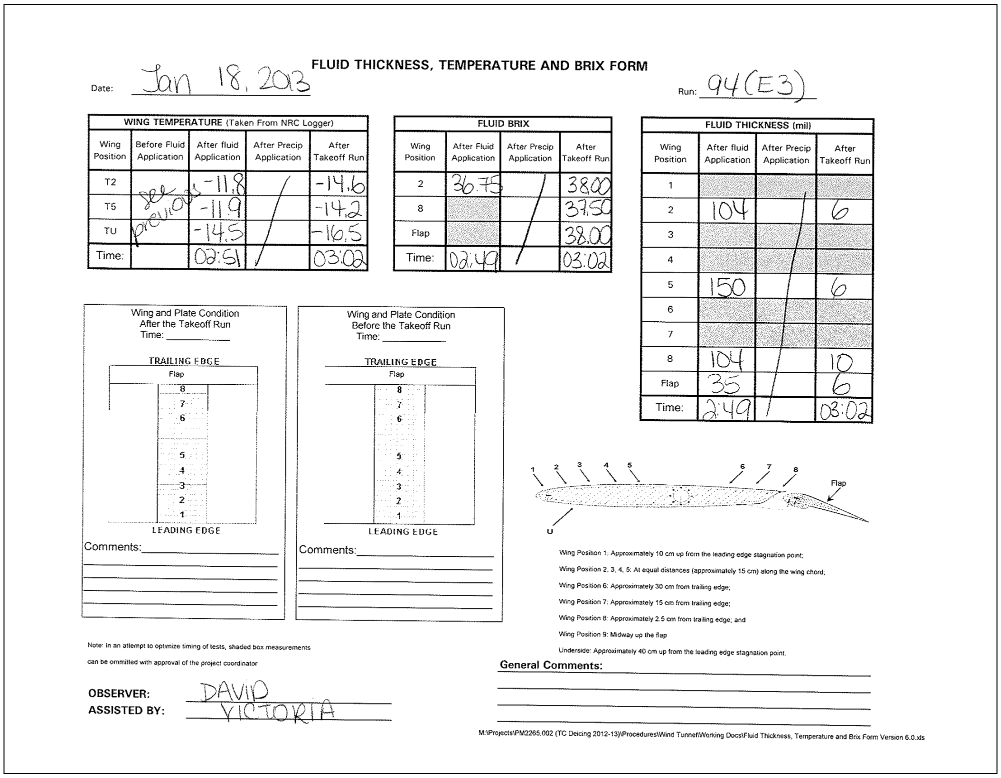
Figure C34: Test #93



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 18, 2013

Run: 94(E3)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-11.8	/	-14.6
T5		-11.9		-14.2
TU		-14.5		-16.5
Time:		02:51		03:02

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	/	38.00
8			37.50
Flap			38.00
Time:	02:49		03:02

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	104		6
3			
4			
5	150		6
6			
7			
8	104		10
Flap	35		6
Time:	2:49		03:02

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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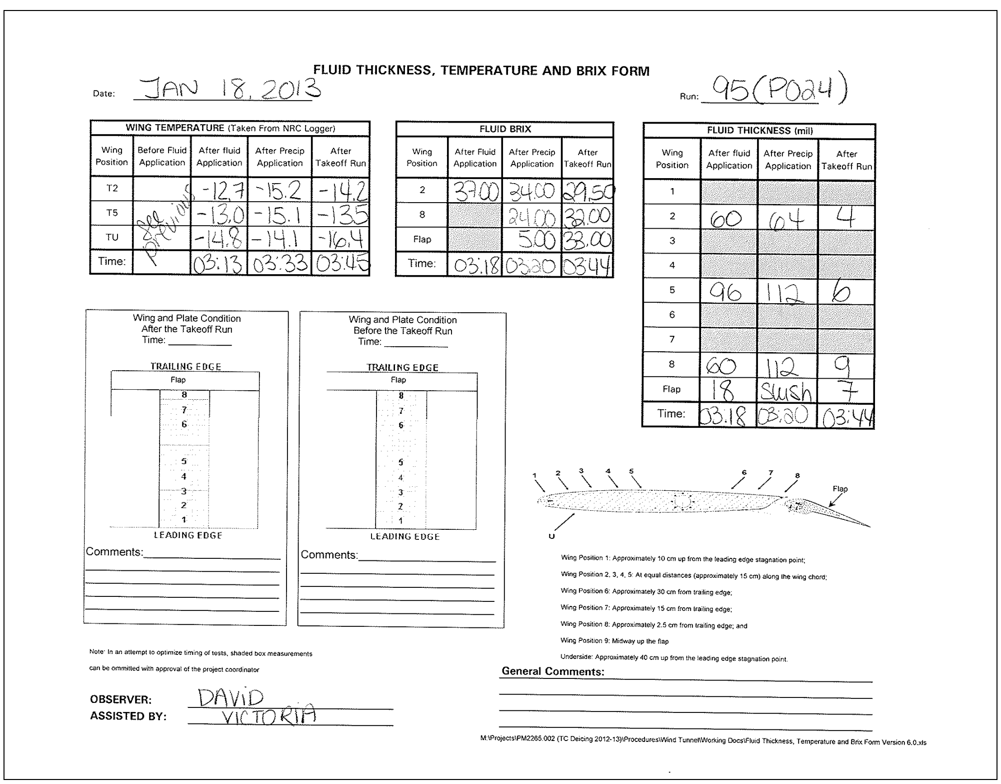
Figure C35: Test #94



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 18, 2013

Run: 95(P024)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-12.7	-15.2	-14.2
T5		-13.0	-15.1	-13.5
TU		-14.8	-14.1	-16.4
Time:		03:13	03:33	03:45

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	34.00	29.50
8		24.00	32.00
Flap		5.00	33.00
Time:	03:18	03:20	03:44

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	64	4
3			
4			
5	96	112	6
6			
7			
8	60	112	9
Flap	18	Slush	7
Time:	03:18	03:20	03:44

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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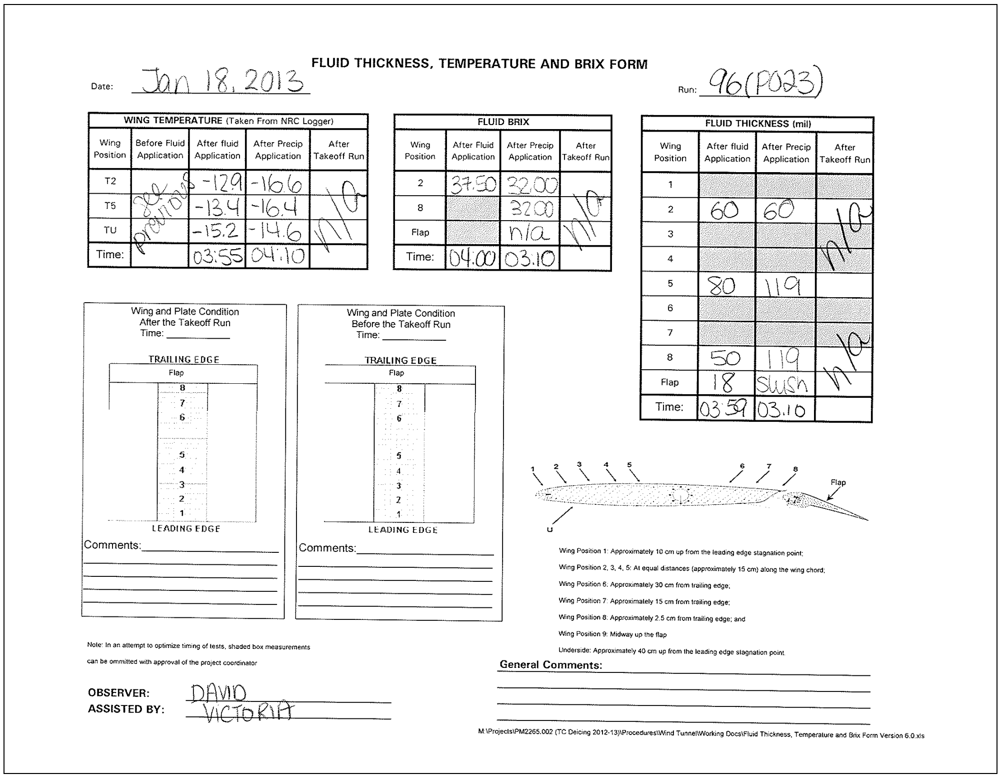
Figure C36: Test #95



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 18, 2013 Run: 96(P023)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-12.9	-16.6	n/a
T5		-13.4	-16.4	
TU		-15.2	-14.6	
Time:		03:55	04:10	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	32.00	n/a
8		32.00	
Flap		n/a	
Time:	04.00	03.10	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	60	n/a
3			
4			
5	80	119	
6			
7			
8	50	119	n/a
Flap	18	Slush	
Time:	03:59	03.10	

Wing and Plate Condition After the Takeoff Run Time:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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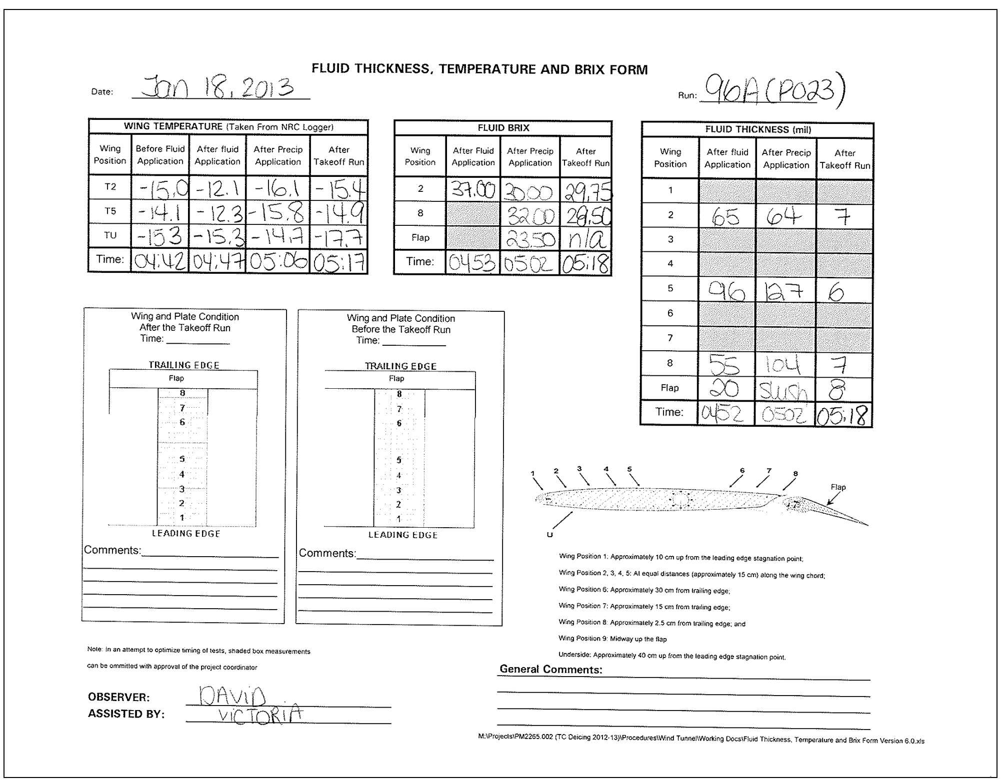
Figure C37: Test #96



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 18, 2013 Run: 96A(P023)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-15.0	-12.1	-16.1	-15.4
T5	-14.1	-12.3	-15.8	-14.9
TU	-15.3	-15.3	-14.7	-17.7
Time:	04:42	04:47	05:06	05:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	30.00	29.75
8		32.00	28.50
Flap		23.50	n/a
Time:	04:53	05:02	05:18

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	64	7
3			
4			
5	96	127	6
6			
7			
8	55	104	7
Flap	20	Slush	8
Time:	04:52	05:02	05:18

Wing and Plate Condition After the Takeoff Run Time:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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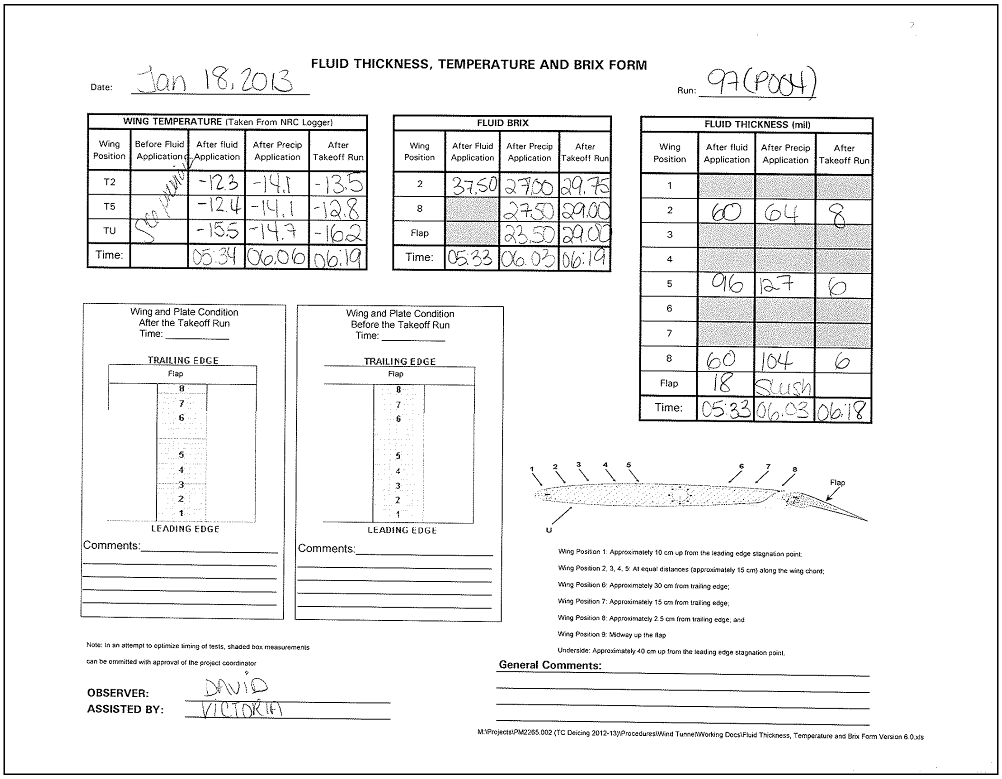
Figure C38: Test #96A



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 18, 2013 Run: 97 (P004)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-12.3	-14.1	-13.5
T5		-12.4	-14.1	-12.8
TU		-15.5	-14.7	-16.2
Time:		05:34	06:06	06:19

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	27.00	29.75
8		27.50	29.00
Flap		23.50	29.00
Time:	05:33	06:03	06:19

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	64	8
3			
4			
5	96	127	6
6			
7			
8	60	104	6
Flap	18	Slush	
Time:	05:33	06:03	06:18

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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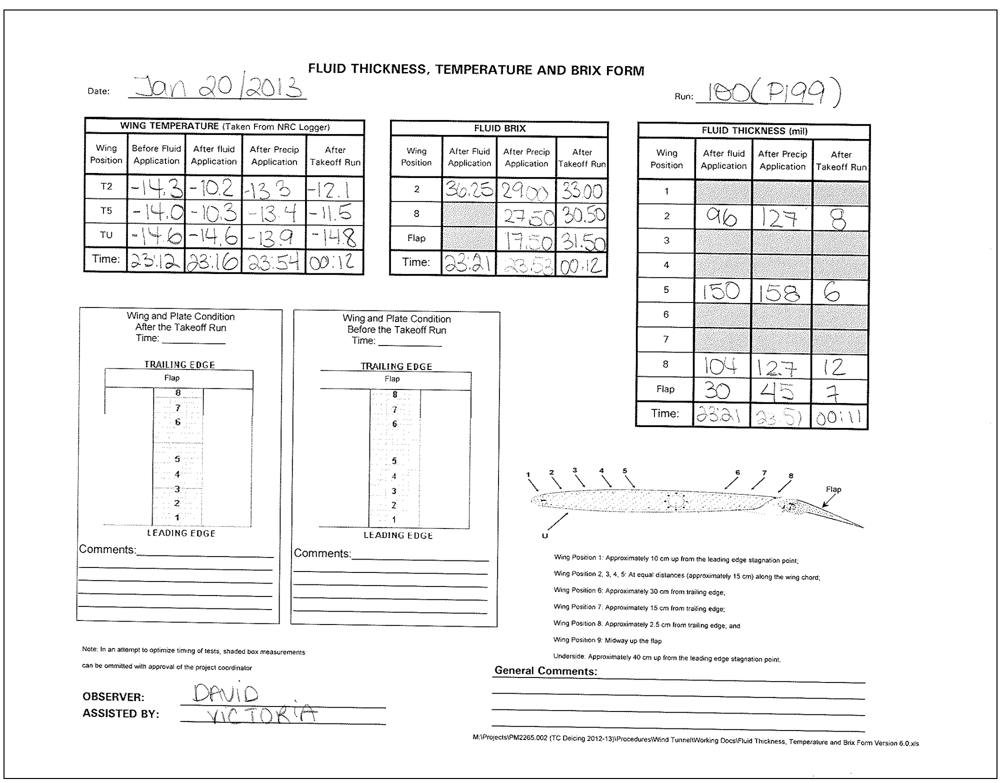
Figure C39: Test #97



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 20/2013 Run: 100 (P199)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.3	-10.2	-13.3	-12.1
T5	-14.0	-10.3	-13.4	-11.5
TU	-14.6	-14.6	-13.9	-14.8
Time:	23:12	23:16	23:54	00:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.25	29.00	33.00
8		27.50	30.50
Flap		17.50	31.50
Time:	23:21	23:53	00:12

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	8
3			
4			
5	150	158	6
6			
7			
8	104	127	12
Flap	30	45	7
Time:	23:21	23:51	00:11

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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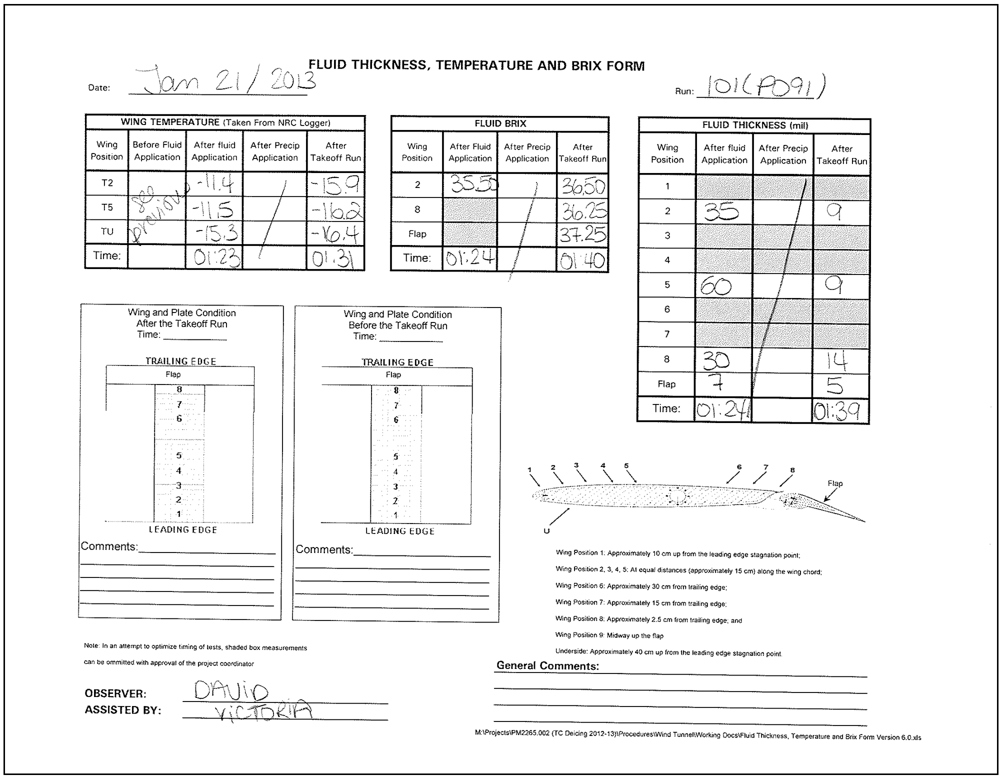
Figure C40: Test #100



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 21/2013 Run: 101(PD91)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-11.4	/	-15.9
T5		-11.5	/	-16.2
TU		-15.3	/	-16.4
Time:		01:23	/	01:31

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.50	/	36.50
8		/	36.25
Flap		/	37.25
Time:	01:24	/	01:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	35	/	9
3		/	
4		/	
5	60	/	9
6		/	
7		/	
8	30	/	14
Flap	7		5
Time:	01:24		01:39

Wing and Plate Condition After the Takeoff Run Time: ______
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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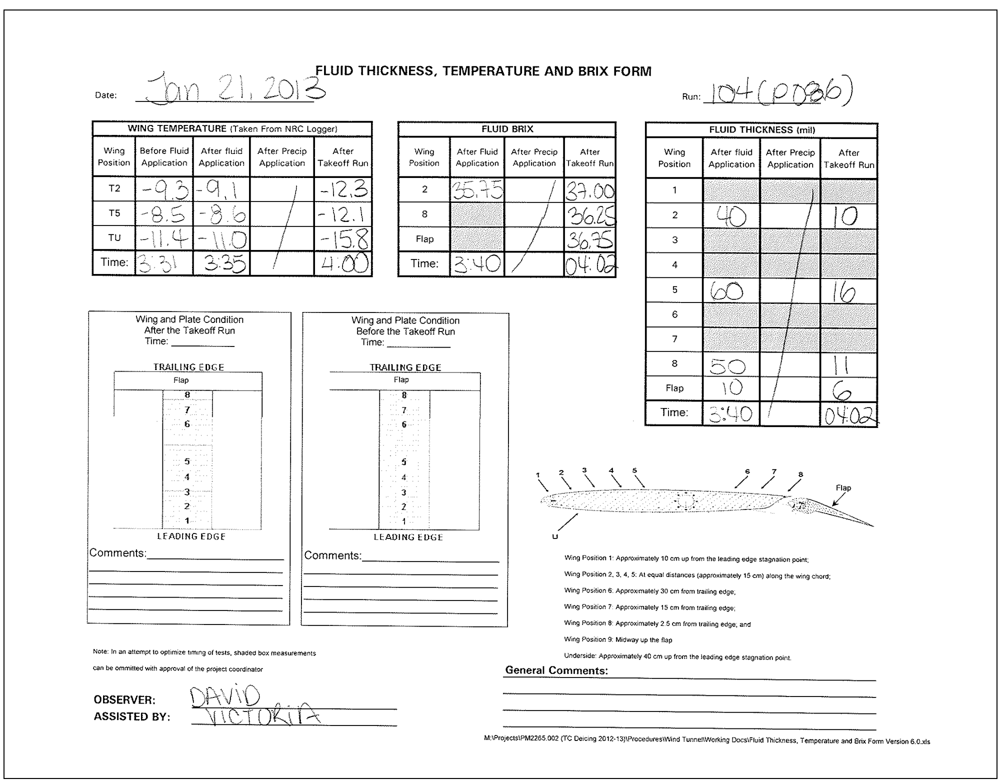
Figure C41: Test #101



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 21, 2013 Run: 104(PD36)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-9.3	-9.1	/	-12.3
T5	-8.5	-8.6	/	-12.1
TU	-11.4	-11.0	/	-15.8
Time:	3:31	3:35	/	4:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	35.75	/	37.00
8		/	36.25
Flap		/	36.75
Time:	3:40	/	04:02

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	40	/	10
3		/	
4		/	
5	60	/	16
6		/	
7		/	
8	50	/	11
Flap	10	/	6
Time:	3:40	/	04:02

Wing and Plate Condition After the Takeoff Run Time: ______
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C42: Test #104

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 21, 2013

Run: 105 (E4)

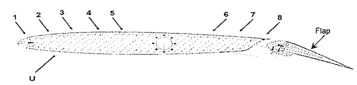
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-11.6	/	-14.2
T5		-11.5	/	-14.5
TU		-13.1	/	-16.7
Time:		04:25	/	04:43

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.25	/	39.00
8		/	37.50
Flap		/	38.00
Time:	04:30	/	04:48

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	/	9
3			
4			
5	119	/	6
6			
7			
8	119	/	22
Flap	35	/	9
Time:	04:29	/	4:48

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap 8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C43: Test #105

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 21/2013

Run: 106 (E5)

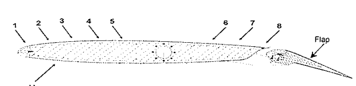
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-13.1	/	-15.0
T5		-13.4	/	-15.0
TU		-15.1	/	-18.3
Time:		05:03	/	05:12

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	/	35.75
8		/	34.25
Flap		/	34.50
Time:	05:04	/	05:20

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	/	9
3			
4			
5	150	/	10
6			
7			
8	127	/	18
Flap	35	/	9
Time:	5:03	/	05:19

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap 8 7 6 5 4 3 2 1
LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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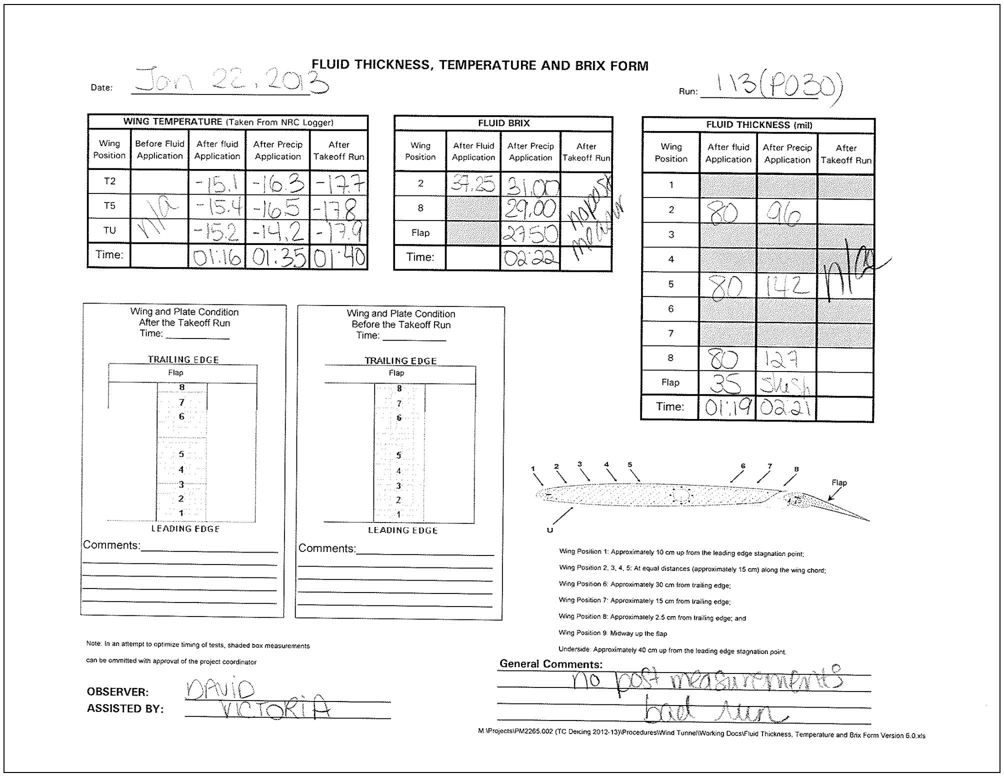
Figure C44: Test #106



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22, 2013

Run: 113(P030)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2		-15.1	-16.3	-17.7
T5	n/a	-15.4	-16.5	-17.8
TU		-15.2	-14.2	-17.9
Time:		01:16	01:35	01:40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	31.00	no post measure
8		29.00	
Flap		27.50	
Time:		02:22	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	96	
3			
4			
5	80	142	n/a
6			
7			
8	80	127	
Flap	35	slush	
Time:	01:19	02:21	

Wing and Plate Condition After the Takeoff Run Time:

Wing and Plate Condition Before the Takeoff Run Time:

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

Comments:

Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

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

General Comments: no post measurements bad run

OBSERVER: DAVID
ASSISTED BY: VICTORIA

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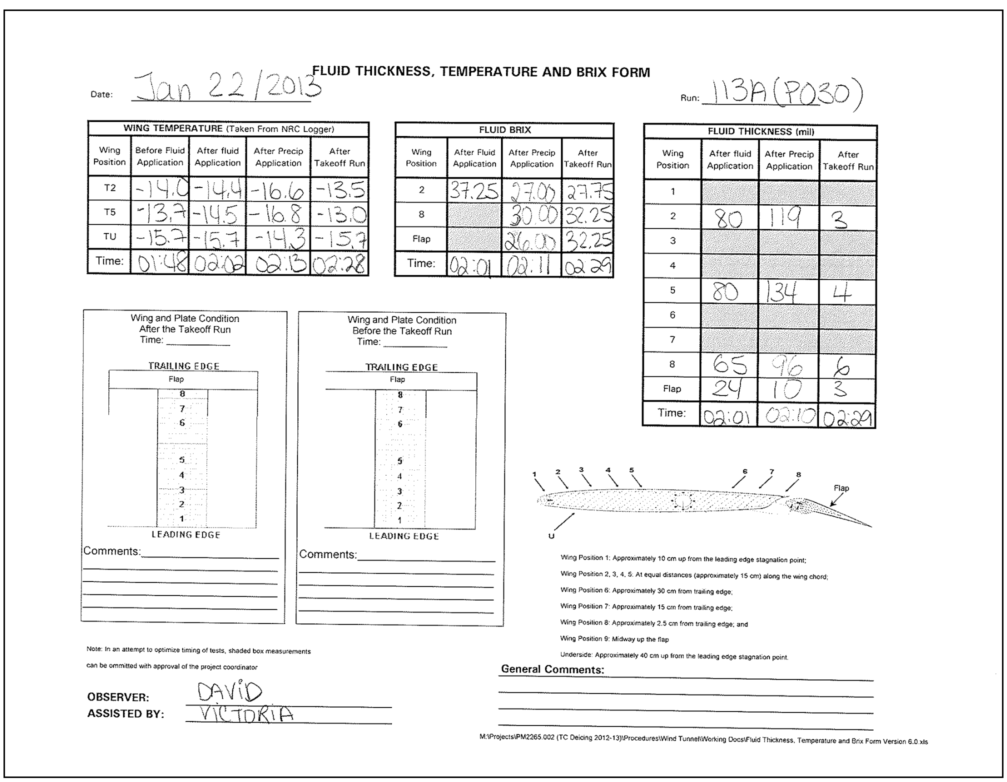
Figure C45: Test #113



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22/2013

Run: 113A(P030)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-14.0	-14.4	-16.6	-13.5
T5	-13.7	-14.5	-16.8	-13.0
TU	-15.7	-15.7	-14.3	-15.7
Time:	01:48	02:02	02:13	02:28

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	27.00	27.75
8		30.00	32.25
Flap		26.00	32.25
Time:	02:01	02:11	02:29

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	119	3
3			
4			
5	80	134	4
6			
7			
8	65	96	6
Flap	24	10	3
Time:	02:01	02:10	02:29

Wing and Plate Condition After the Takeoff Run Time:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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Figure C46: Test #113A

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22/2013

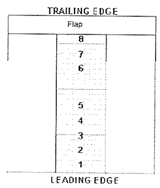
Run: 114 (P166)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-12.3	-13.7	-15.5
T5		-12.6	-13.6	-16.5
TU		-13.9	-12.8	-16.5
Time:		02:50	03:07	03:16

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	28.00	33.50
8		27.50	34.00
Flap		24.25	32.00
Time:	02:52	03:14	03:24

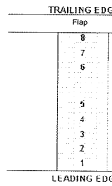
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	96	2
3			
4			
5	127	150	6
6			
7			
8	104	127	10
Flap	30	40	4
Time:	02:50	03:14	03:24

Wing and Plate Condition
After the Takeoff Run
Time: ________

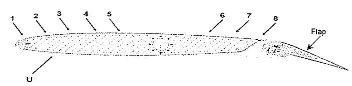


Comments: ________

Wing and Plate Condition
Before 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: DY

ASSISTED BY: JB

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Figure C47: Test #114

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: JAN 22, 2013

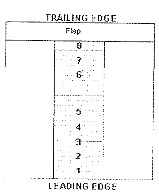
Run: 115 (P164)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-11.1	-13.3	-11.7
T5		-11.4	-13.1	-11.1
TU		-13.1	-12.7	-14.1
Time:		03:43	03:59	04:15

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	27.00	35.00
8		29.50	33.00
Flap		24.50	33.00
Time:	03:43	03:55	04:15

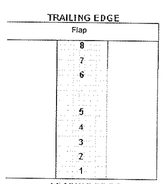
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	96	5
3			
4			
5	150	158	5
6			
7			
8	80	112	10
Flap	30	55	8
Time:	03:43	03:55	04:14

Wing and Plate Condition
After the Takeoff Run
Time: ________

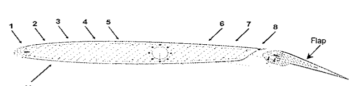


Comments: ________

Wing and Plate Condition
Before 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: DY

ASSISTED BY: VB

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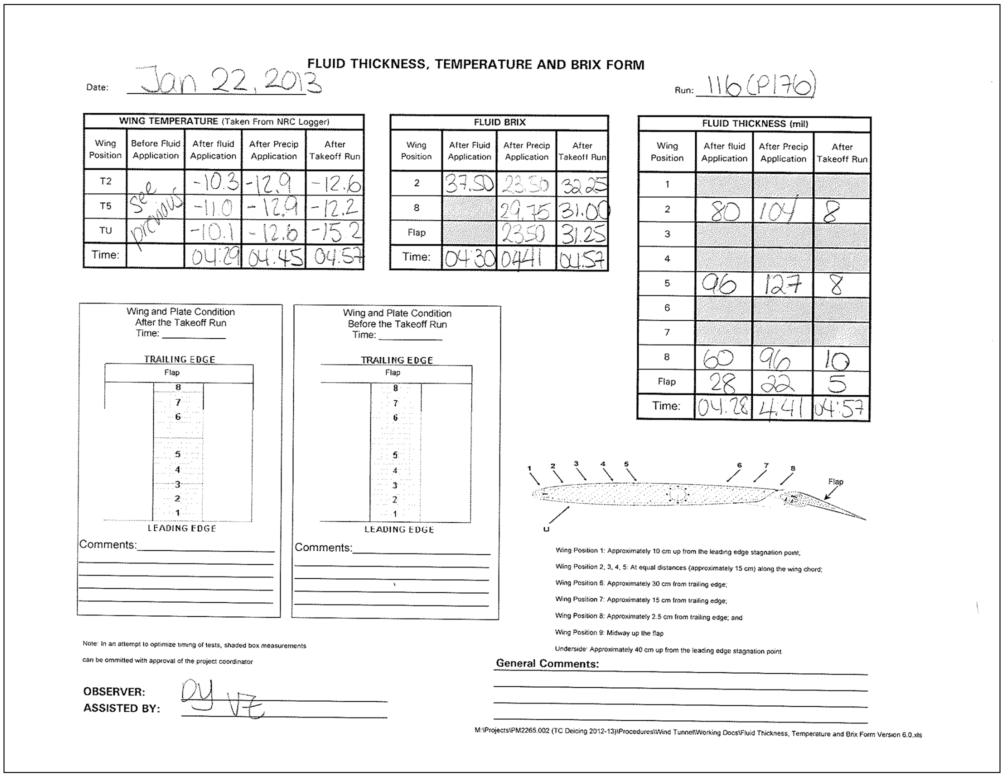
Figure C48: Test #115



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22, 2013

Run: 116 (P176)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-10.3	-12.9	-12.6
T5		-11.0	-12.9	-12.2
TU		-10.1	-12.6	-15.2
Time:		04:29	04:45	04:57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	23.50	32.25
8		29.75	31.00
Flap		23.50	31.25
Time:	04:30	04:41	04:57

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	104	8
3			
4			
5	96	127	8
6			
7			
8	60	96	10
Flap	28	22	5
Time:	04:28	4:41	04:57

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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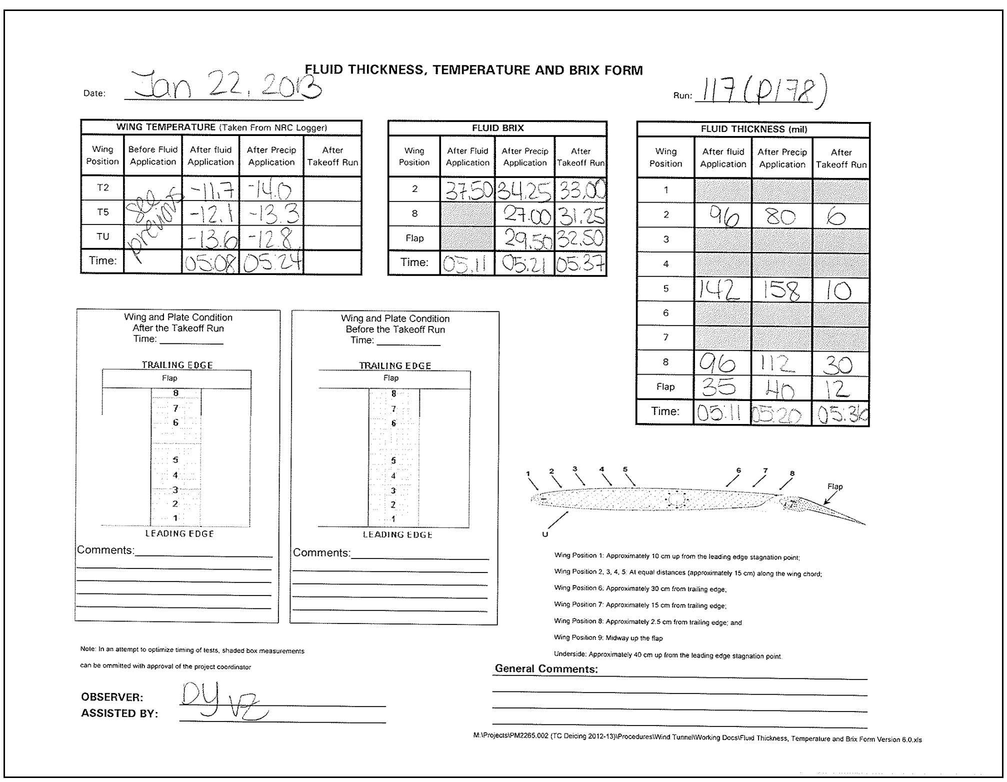
Figure C49: Test #116



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22, 2013

Run: 117 (P178)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-11.7	-14.0	
T5		-12.1	-13.3	
TU		-13.6	-12.8	
Time:		05:08	05:24	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	34.25	33.00
8		27.00	31.25
Flap		29.50	32.50
Time:	05:11	05:21	05:37

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	80	6
3			
4			
5	142	158	10
6			
7			
8	96	112	30
Flap	35	40	12
Time:	05:11	05:20	05:36

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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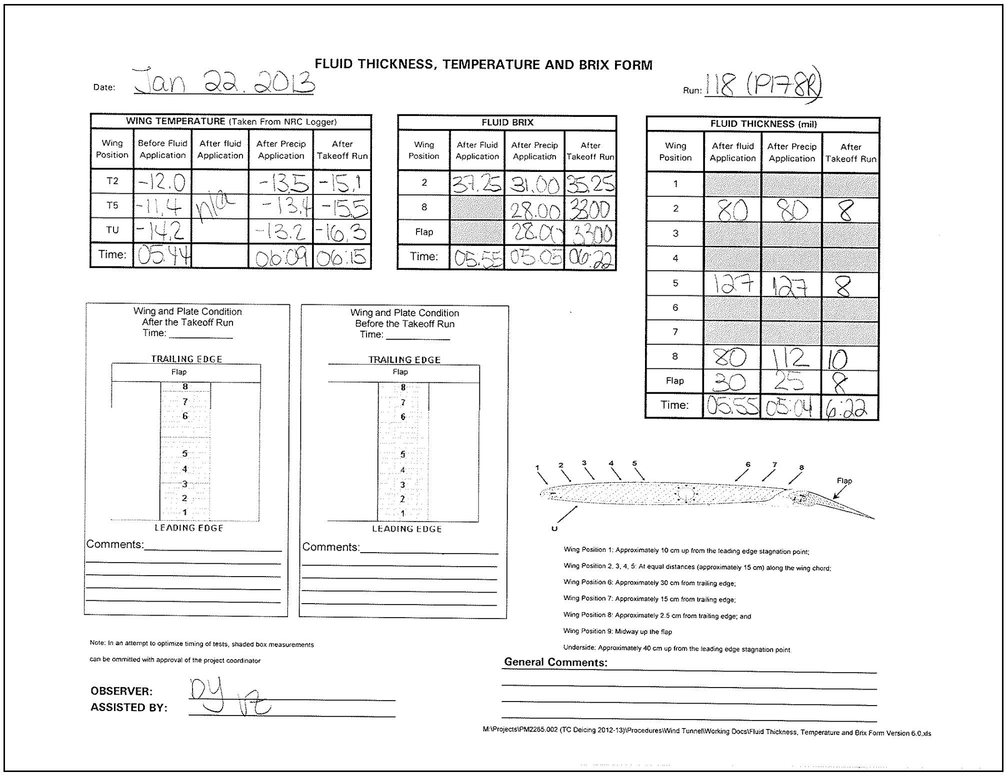
Figure C50: Test #117



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22, 2013

Run: 118 (P178R)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-12.0	n/a	-13.5	-15.1
T5	-11.4		-13.4	-15.5
TU	-14.2		-13.2	-16.3
Time:	05:44		06:09	06:15

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	31.00	35.25
8		28.00	33.00
Flap		28.00	33.00
Time:	05:55	05:05	06:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	80	8
3			
4			
5	127	127	8
6			
7			
8	80	112	10
Flap	30	25	8
Time:	05:55	05:04	6:22

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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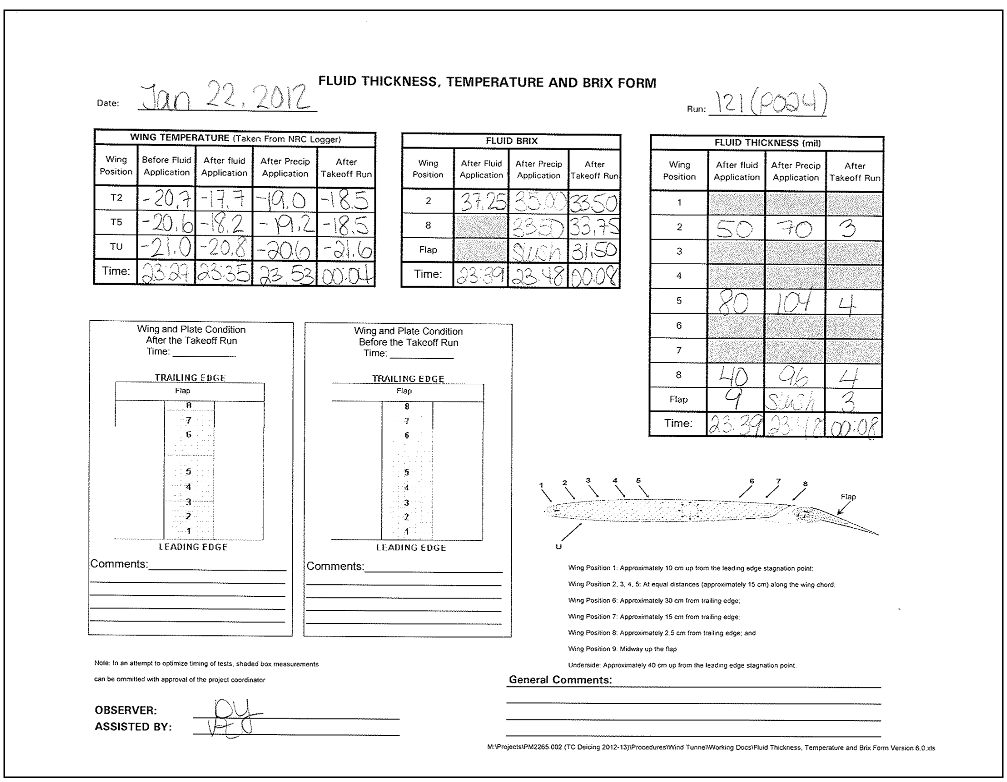
Figure C51: Test #118



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22, 2012

Run: 121 (P024)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-20.7	-17.7	-19.0	-18.5
T5	-20.6	-18.2	-19.2	-18.5
TU	-21.0	-20.8	-20.6	-21.6
Time:	23:29	23:35	23:53	00:04

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	35.00	33.50
8		33.50	33.75
Flap		Slush	31.50
Time:	23:39	23:48	00:08

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	50	70	3
3			
4			
5	80	104	4
6			
7			
8	40	96	4
Flap	9	Slush	3
Time:	23:39	23:48	00:08

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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Figure C52: Test #121

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23, 2013

Run: 122 (P114)

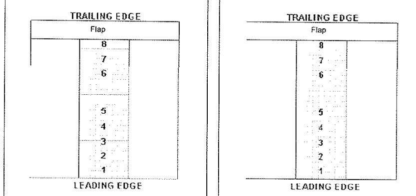
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-15.9	/	-19.5
T5		-16.4	/	-18.5
TU		-20.3	/	-21.1
Time:		00:21		00:43

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	29.75	/	32.00
8		/	31.00
Flap		/	30.75
Time:	00:24	/	00:40

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	/	7
3			
4			
5	80	/	8
6			
7			
8	65	/	11
Flap	16	/	7
Time:	00:24	/	00:41

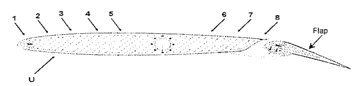
Wing and Plate Condition After the Takeoff Run Time: ________

Wing and Plate Condition Before the Takeoff Run Time: ________



Comments:________

Comments:________



Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

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

General Comments:

OBSERVER:
ASSISTED BY:

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Figure C53: Test #122

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/2013

Run: 123 (P132)

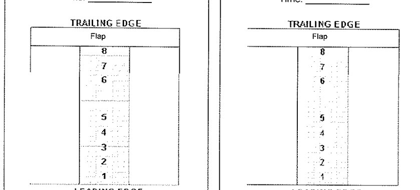
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-16.7	/	-18.1
T5		-16.7	/	-17.8
TU		-20.8	/	-20.8
Time:		00:57	/	01:18

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	31.00	/	33.00
8		/	31.25
Flap		/	31.25
Time:	00:59	/	1:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	64	/	4
3			
4			
5	96	/	7
6			
7			
8	80	/	7
Flap	20	/	4
Time:	00:58	/	1:12

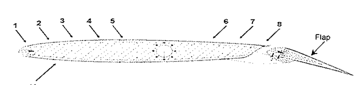
Wing and Plate Condition After the Takeoff Run Time: ________

Wing and Plate Condition Before the Takeoff Run Time: ________



Comments:________

Comments:________



Wing Position 1: Approximately 10 cm up from the leading edge stagnation point;
Wing Position 2, 3, 4, 5: At equal distances (approximately 15 cm) along the wing chord;
Wing Position 6: Approximately 30 cm from trailing edge;
Wing Position 7: Approximately 15 cm from trailing edge;
Wing Position 8: Approximately 2.5 cm from trailing edge; and
Wing Position 9: Midway up the flap
Underside: Approximately 40 cm up from the leading edge stagnation point.

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

General Comments:

OBSERVER: PY
ASSISTED BY: VB

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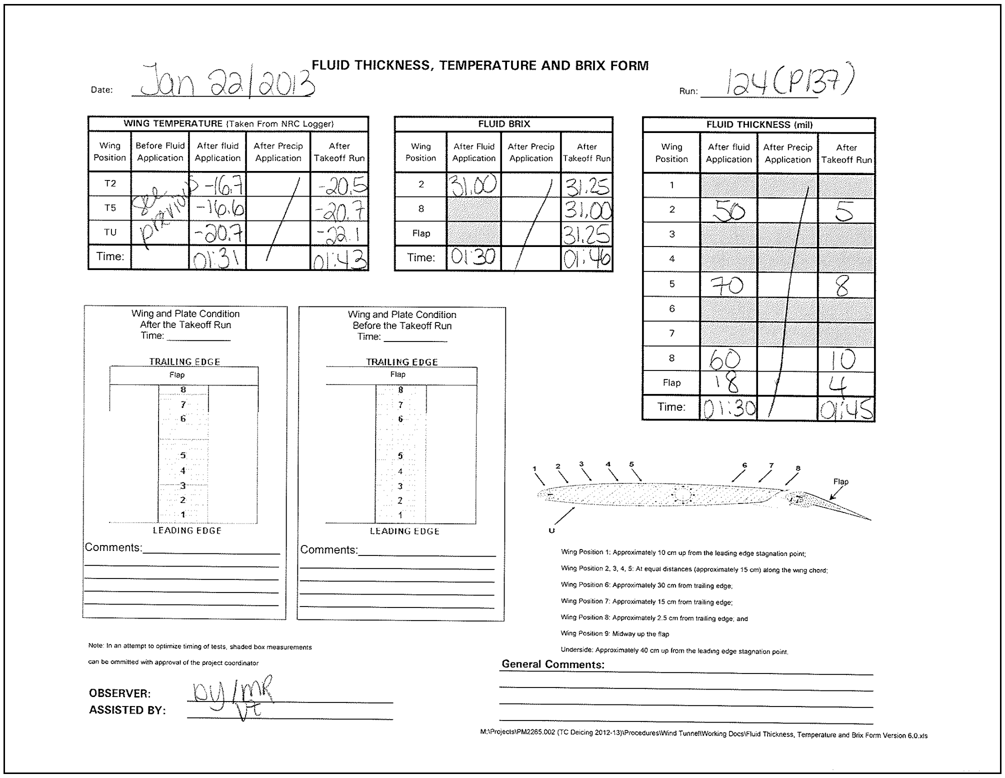
Figure C54: Test #123



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 22/2013 Run: 124 (P137)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-16.7	/	-20.5
T5		-16.6	/	-20.7
TU		-20.7	/	-22.1
Time:		01:31	/	01:43

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	31.00	/	31.25
8		/	31.00
Flap		/	31.25
Time:	01:30	/	01:46

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	50	/	5
3		/	
4		/	
5	70	/	8
6		/	
7		/	
8	60	/	10
Flap	18	/	4
Time:	01:30	/	01:45

Wing and Plate Condition After the Takeoff Run Time: ______ — TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE — Comments: ______

Wing and Plate Condition Before 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: DY/MR
ASSISTED BY: VL

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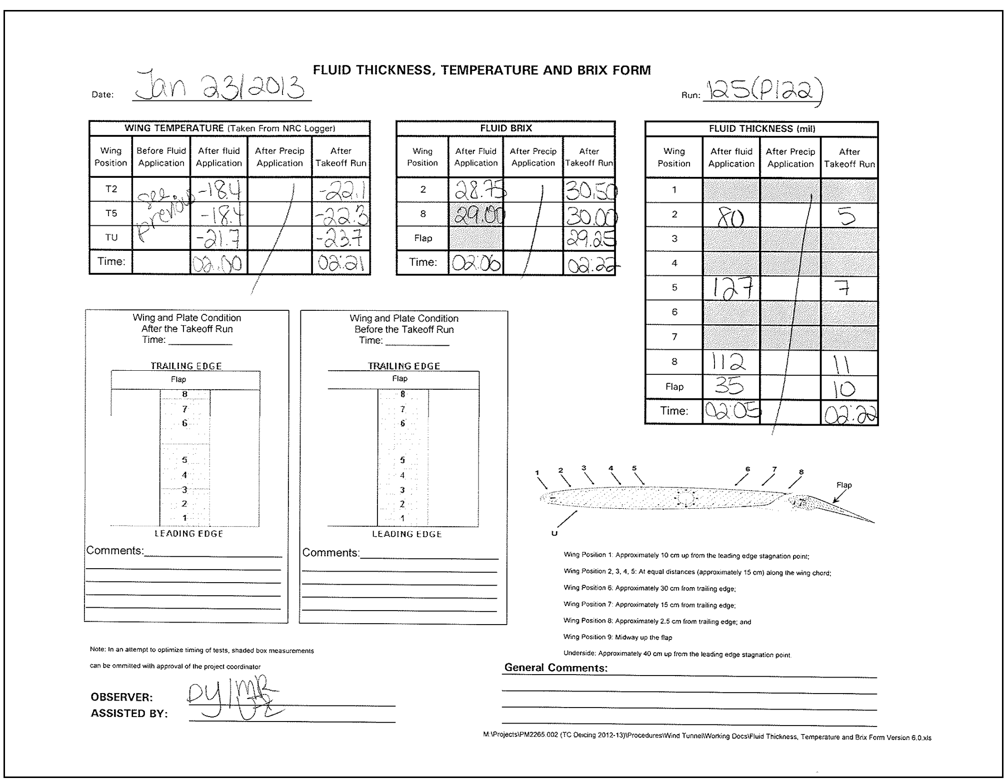
Figure C55: Test #124



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/2013 Run: 125 (P122)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-18.4	/	-22.1
T5		-18.4	/	-22.3
TU		-21.7	/	-23.7
Time:		02:00	/	02:21

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	28.75	/	30.50
8	29.00	/	30.00
Flap		/	29.25
Time:	02:06	/	02:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	80	/	5
3		/	
4		/	
5	127	/	7
6		/	
7		/	
8	112	/	11
Flap	35	/	10
Time:	02:05	/	02:22

Wing and Plate Condition After the Takeoff Run Time: ______ — TRAILING EDGE, Flap, 8, 7, 6, 5, 4, 3, 2, 1, LEADING EDGE — Comments: ______

Wing and Plate Condition Before 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: DY/MR
ASSISTED BY: VL

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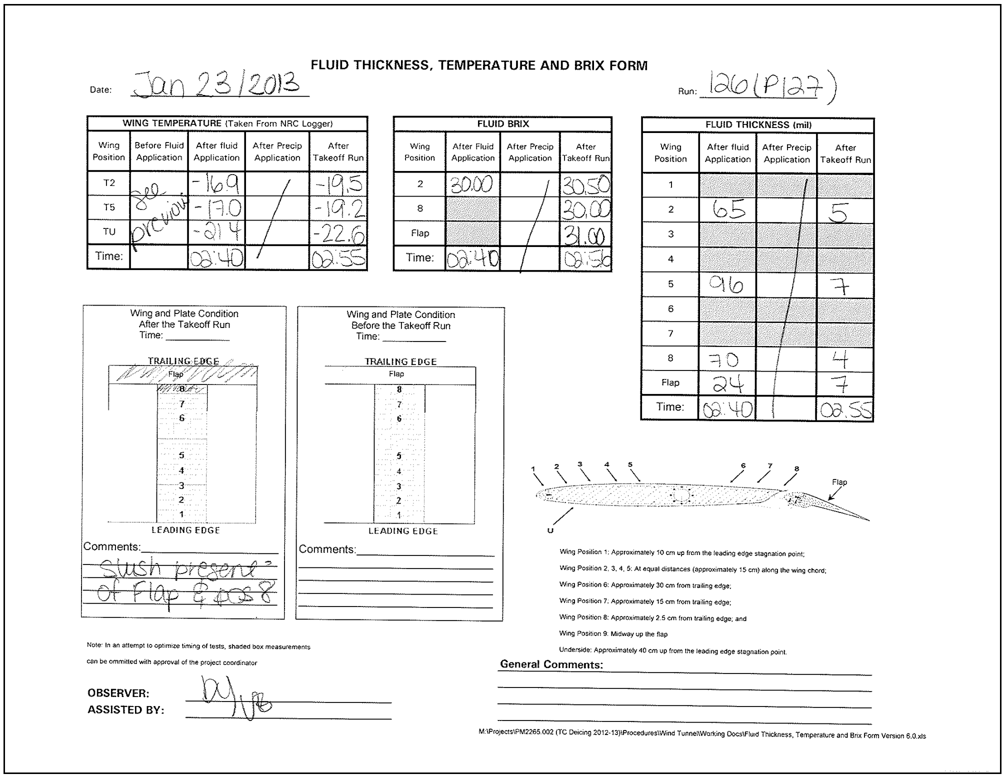
Figure C56: Test #125



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/2013 Run: 126 (P127)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-16.9	/	-19.5
T5		-17.0	/	-19.2
TU		-21.4	/	-22.6
Time:		02:40	/	02:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	30.00	/	30.50
8		/	30.00
Flap		/	31.00
Time:	02:40	/	02:56

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	65	/	5
3		/	
4		/	
5	96	/	7
6		/	
7		/	
8	70	/	4
Flap	24	/	7
Time:	02:40	/	02:55

Wing and Plate Condition After the Takeoff Run Time: ____
TRAILING EDGE / Flap / 8 / 7 / 6 / 5 / 4 / 3 / 2 / 1 / LEADING EDGE
Comments: Slush present of Flap & pos 8

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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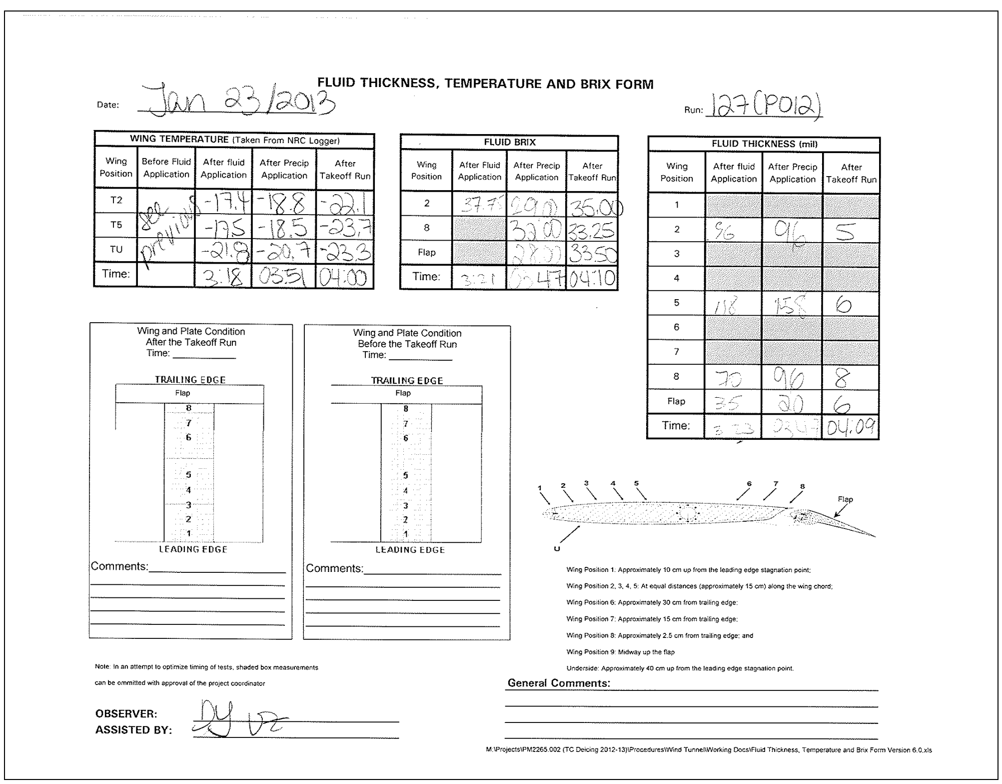
Figure C57: Test #126



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/2013 Run: 127 (P012)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-17.4	-18.8	-22.1
T5		-17.5	-18.5	-23.7
TU		-21.8	-20.7	-23.3
Time:		3:18	03:51	04:00

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	29.00	35.00
8		32.00	33.25
Flap		28.00	33.50
Time:	3:21	03:47	04:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	96	5
3			
4			
5	118	158	6
6			
7			
8	70	96	8
Flap	35	20	6
Time:	3:23	03:47	04:09

Wing and Plate Condition After the Takeoff Run Time: ____
TRAILING EDGE / Flap / 8 / 7 / 6 / 5 / 4 / 3 / 2 / 1 / LEADING EDGE
Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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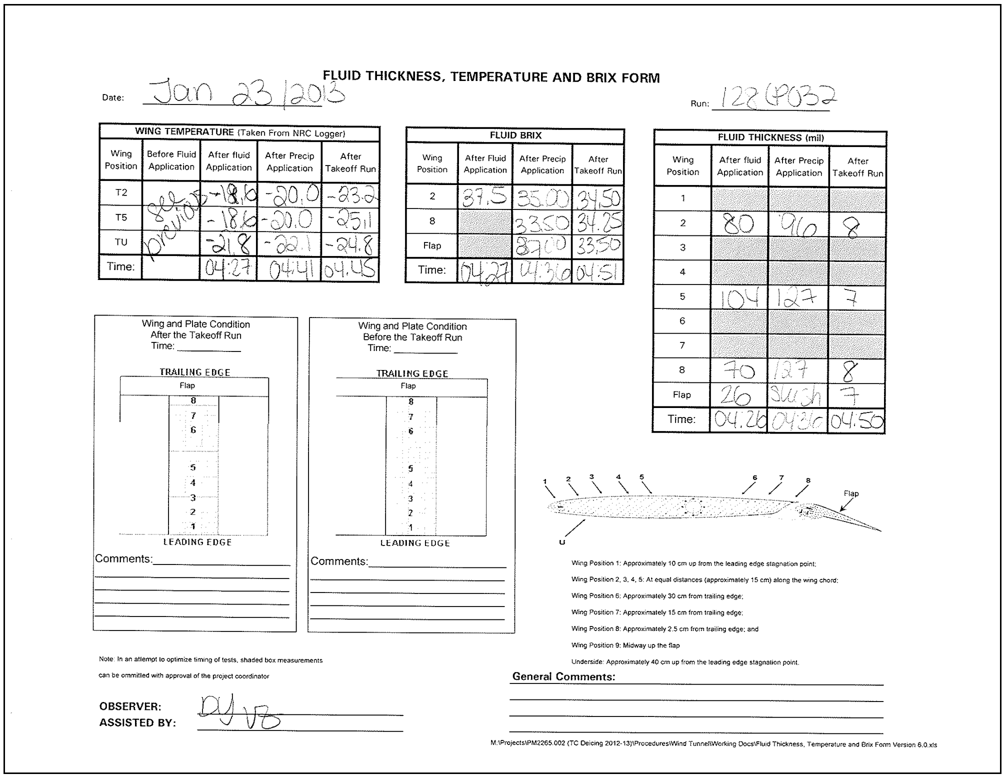
Figure C58: Test #127



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/2013 Run: 128(P032

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-18.6	-20.0	-23.2
T5		-18.6	-20.0	-25.1
TU		-21.8	-22.1	-24.8
Time:		04:27	04:41	04.45

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.5	35.00	34.50
8		33.50	34.25
Flap		37.00	33.50
Time:	04:27	04:36	04:51

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	96	8
3			
4			
5	104	127	7
6			
7			
8	70	127	8
Flap	26	slush	7
Time:	04:26	04:36	04:50

Wing and Plate Condition After the Takeoff Run Time: ________

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

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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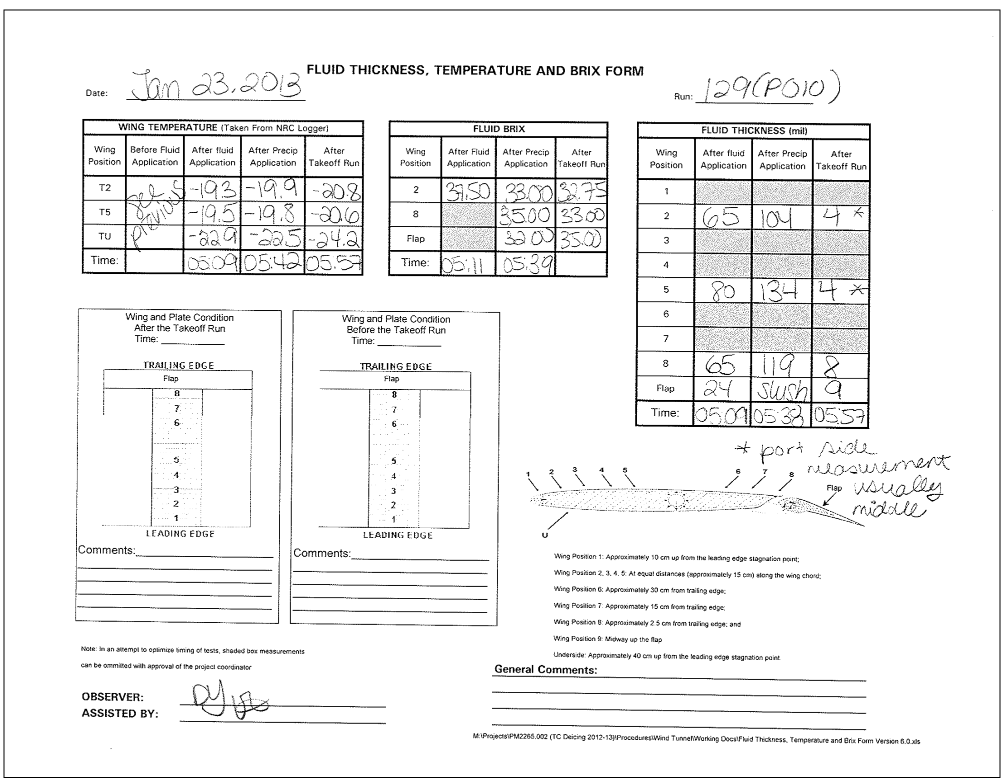
Figure C59: Test #128



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23.2013 Run: 129(P010)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-19.3	-19.9	-20.8
T5		-19.5	-19.8	-20.6
TU		-22.9	-22.5	-24.2
Time:		05:09	05:42	05:57

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	33.00	32.75
8		35.00	33.00
Flap		32.00	35.00
Time:	05:11	05:39	

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	104	4 *
3			
4			
5	80	134	4 *
6			
7			
8	65	119	8
Flap	24	slush	9
Time:	05:09	05:38	05:57

* port side measurement usually middle

Wing and Plate Condition After the Takeoff Run Time: ________

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

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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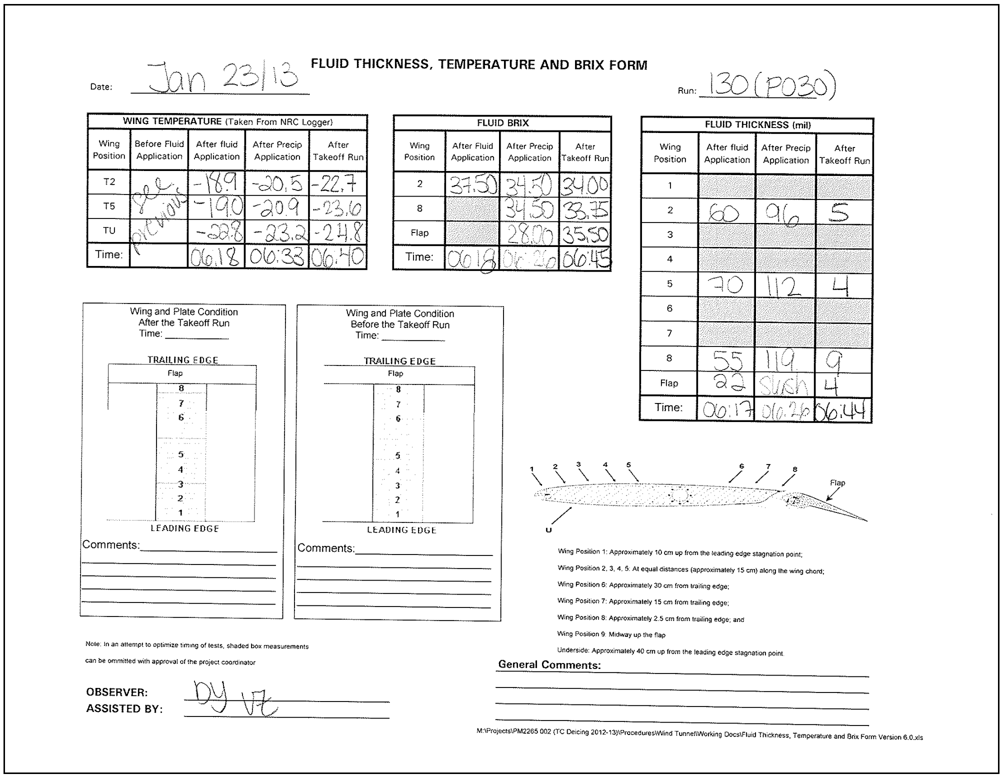
Figure C60: Test #129



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23/13 Run: 130 (P030)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-18.9	-20.5	-22.7
T5		-19.0	-20.9	-23.6
TU		-22.8	-23.2	-24.8
Time:		06:18	06:33	06:40

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	34.50	34.00
8		34.50	33.75
Flap		28.00	35.50
Time:	06:18	06:26	06:45

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	96	5
3			
4			
5	70	112	4
6			
7			
8	55	119	9
Flap	22	Slush	4
Time:	06:17	06:26	06:44

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VT

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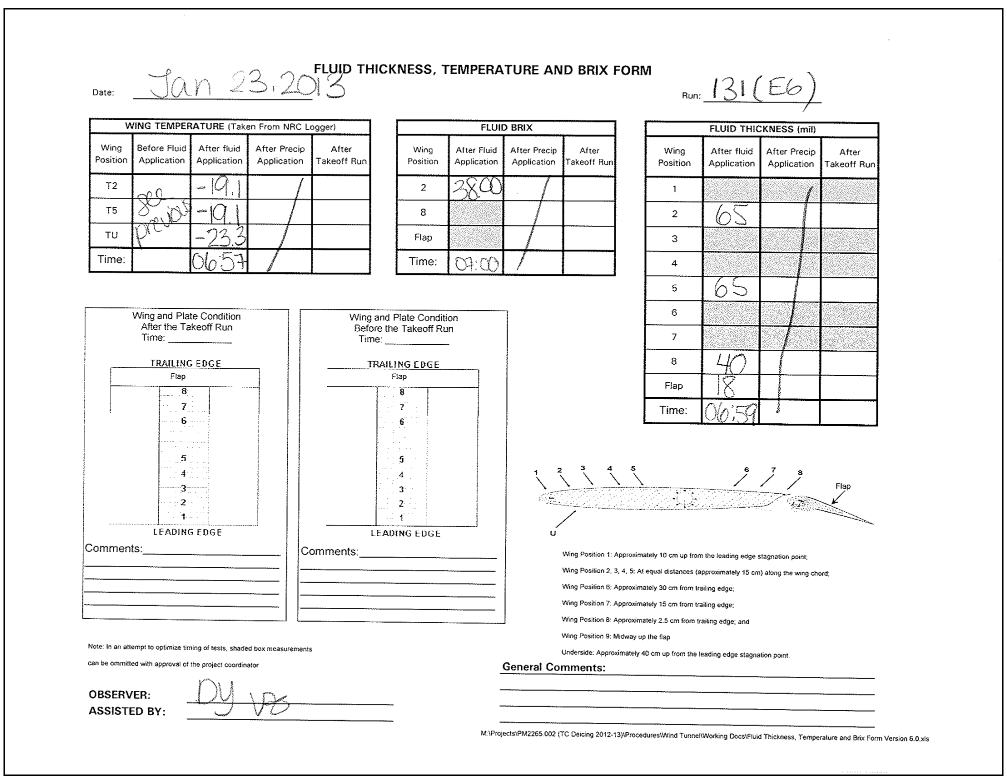
Figure C61: Test #130



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23, 2013 Run: 131 (E6)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-19.1	/	
T5		-19.1		
TU		-23.3		
Time:		06:57		

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.00	/	
8			
Flap			
Time:	07:00		

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	65		
3			
4			
5	65		
6			
7			
8	40		
Flap	18		
Time:	06:59		

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VPS

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Figure C62: Test #131

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23, 2013

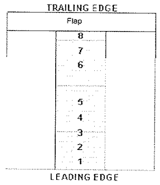
Run: 134 (P028)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-21.5	-19.8	-18.0	-21.3
T5	-21.2	-20.1	-17.9	-21.5
TU	-21.9	-21.1	-20.7	-22.3
Time:	22:41	22:48	23:05	23:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.00	22.00	32.50
8		n/a	29.00
Flap		n/a	32.00
Time:	22:53	22:01	23:21

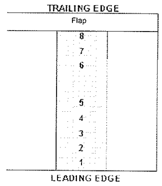
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	26	5	3
3			
4			
5	30	24	3
6			
7			
8	50	3	4
Flap	5	Slush	5
Time:	22:53	22:01	23:20

Wing and Plate Condition After the Takeoff Run
Time: ____________

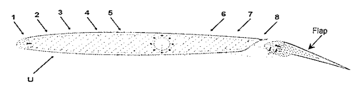


Comments: ____________

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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Figure C63: Test #134

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23, 2013

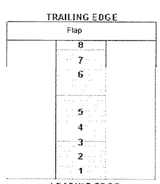
Run: 135 (P124)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-17.8	/	-19.5
T5		-17.6		-18.4
TU		-21.2		-22.0
Time:		23:35		23:51

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	/	39.00
8			37.75
Flap			38.50
Time:	23:34		23:51

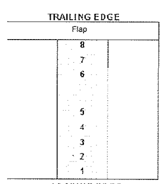
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	26		2
3			
4			
5	30		3
6			
7			
8	24		7
Flap	5		1
Time:	23:33		23:50

Wing and Plate Condition After the Takeoff Run
Time: ____________

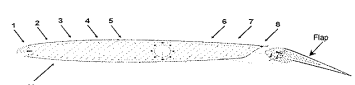


Comments: ____________

Wing and Plate Condition Before 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: DY
ASSISTED BY: VD

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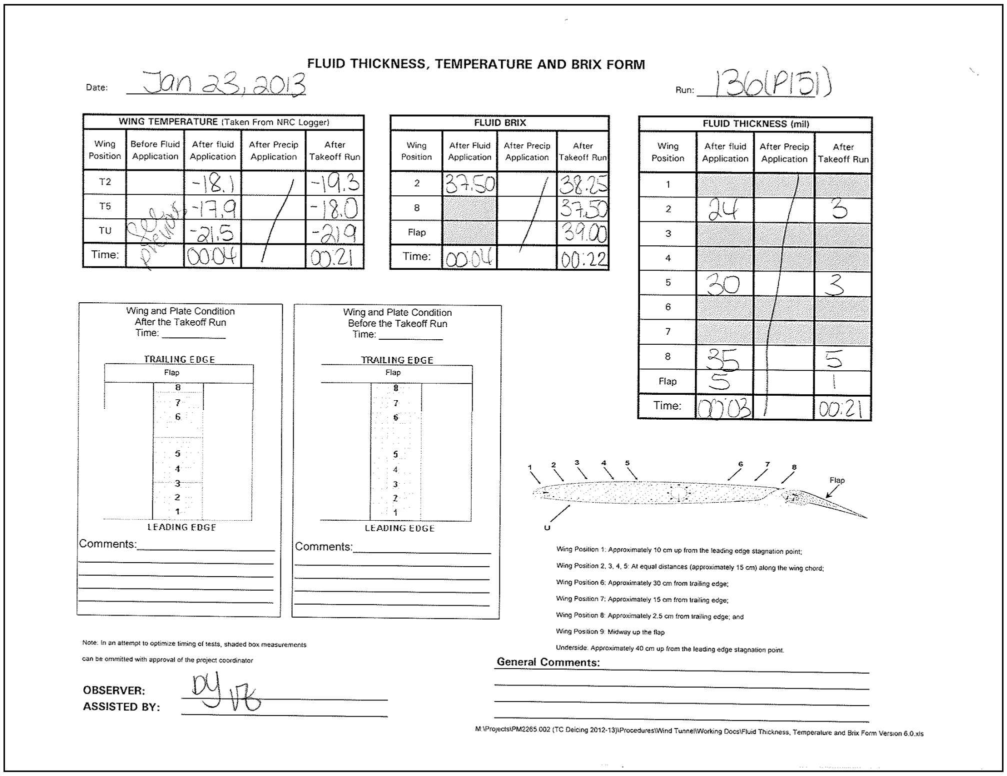
Figure C64: Test #135



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 23, 2013

Run: 136(P151)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-18.1	/	-19.3
T5		-17.9	/	-18.0
TU		-21.5	/	-21.9
Time:		00:04	/	00:21

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	/	38.25
8		/	37.50
Flap		/	39.00
Time:	00:04		00:22

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	24	/	3
3		/	
4		/	
5	30	/	3
6		/	
7		/	
8	35	/	5
Flap	5	/	1
Time:	00:03	/	00:21

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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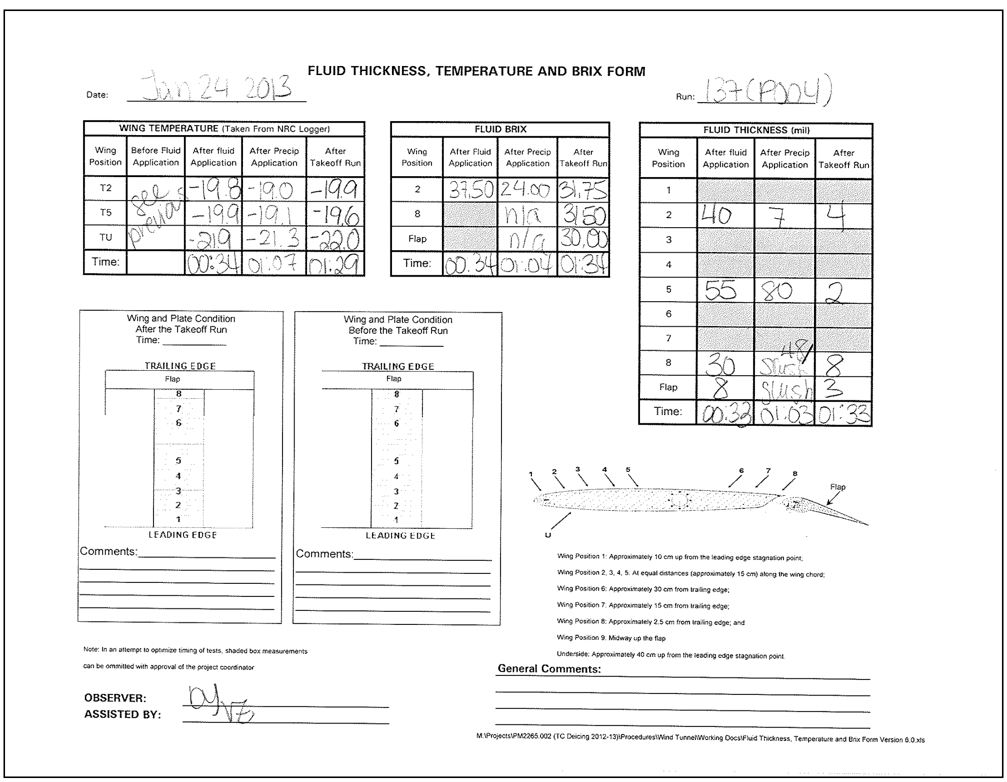
Figure C65: Test #136



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24 2013

Run: 137(P004)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-19.8	-19.0	-19.9
T5		-19.9	-19.1	-19.6
TU		-21.9	-21.3	-22.0
Time:		00:34	01:07	01:29

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	24.00	31.75
8		n/a	31.50
Flap		n/a	30.00
Time:	00:34	01:04	01:34

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	40	7	4
3			
4			
5	55	80	2
6			
7			
8	30	48/ slush	8
Flap	8	slush	3
Time:	00:32	01:03	01:33

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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Figure C66: Test #137

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

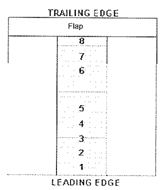
Date: Jan 24, 2013   Run: 138 (P112)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-18.9	/	-19.3
T5		-19.3		-18.8
TU		-21.3		-21.3
Time:		01:49		02:15

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	/	38.25
8			37.50
Flap			38.00
Time:	01:51		02:13

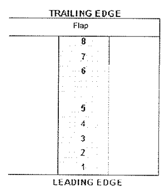
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	35		6
3			
4			
5	60		5
6			
7			
8	40		10
Flap	11		3
Time:	01:49		02:12

Wing and Plate Condition
After the Takeoff Run
Time: ___________

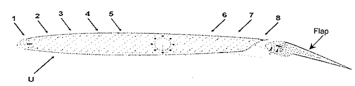


Comments: ___________

Wing and Plate Condition
Before 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: DY
ASSISTED BY: JVZ

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Figure C67: Test #138

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

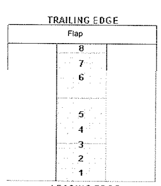
Date: Jan 24, 2013   Run: 139 (P139)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-18.5	/	-19.4
T5		-18.5		-19.6
TU		-21.7		-22.0
Time:		02:22		

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	/	38.50
8			38.00
Flap			38.75
Time:	02:27		02:45

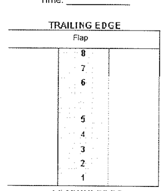
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	40		2
3			
4			
5	60		8
6			
7			
8	40		12
Flap	12		2
Time:	02:25		02:44

Wing and Plate Condition
After the Takeoff Run
Time: ___________

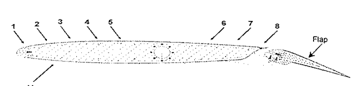


Comments: ___________

Wing and Plate Condition
Before 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: DY
ASSISTED BY: JVZ

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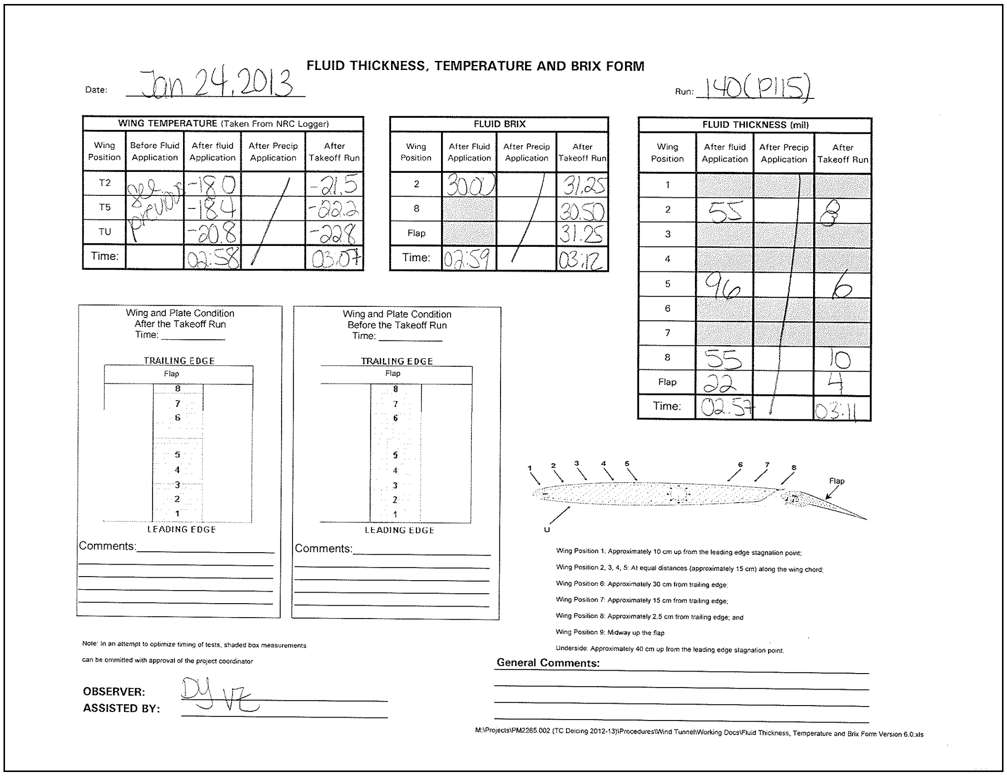
Figure C68: Test #139



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013

Run: 140(P115)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-18.0	/	-21.5
T5		-18.4	/	-22.2
TU		-20.8	/	-22.8
Time:		02:58	/	03:07

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	30.00	/	31.25
8		/	30.50
Flap		/	31.25
Time:	02:59	/	03:12

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	/	8
3			
4			
5	96	/	6
6			
7			
8	55	/	10
Flap	22	/	4
Time:	02:57	/	03:11

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VT

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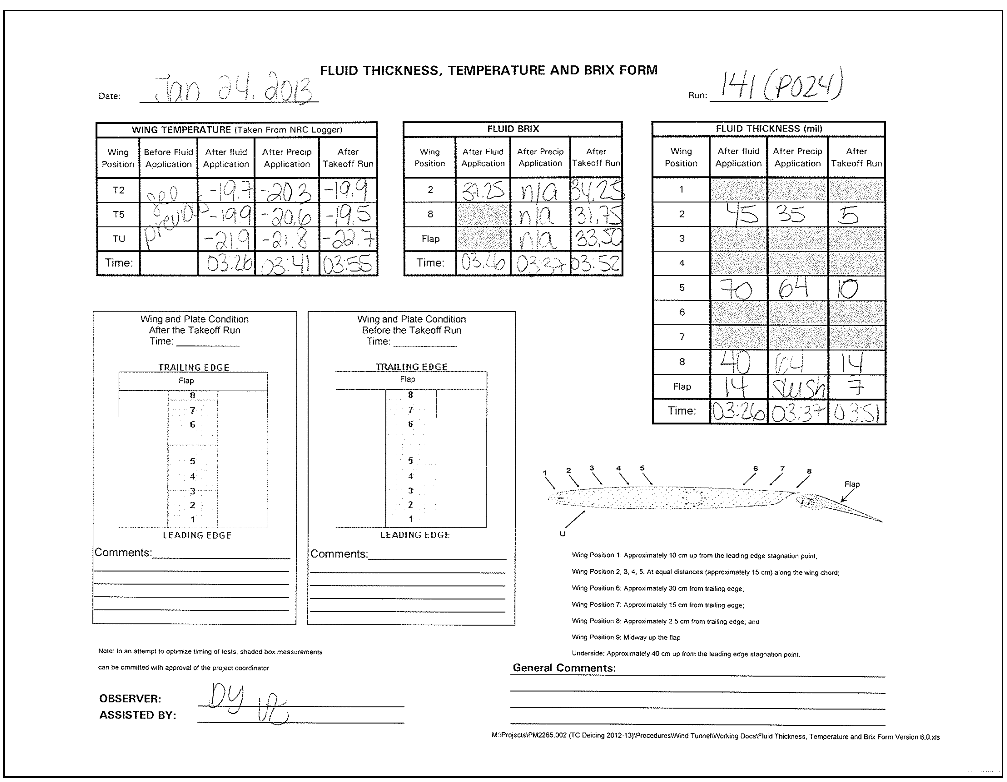
Figure C69: Test #140



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013

Run: 141 (P024)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-19.7	-20.3	-19.9
T5		-19.9	-20.6	-19.5
TU		-21.9	-21.8	-22.7
Time:		03:26	03:41	03:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	32.25	n/a	34.25
8		n/a	31.75
Flap		n/a	33.50
Time:	03:46	03:37	03:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	45	35	5
3			
4			
5	70	64	10
6			
7			
8	40	64	14
Flap	14	slush	7
Time:	03:26	03:37	03:51

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VP

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Figure C70: Test #141

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013

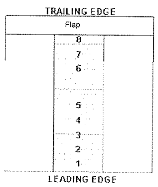
Run: 142 (P030)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-22.1	-21.5	-22.4
T5		-23.0	-21.6	-23.0
TU		-22.2	-22.2	-23.5
Time:		04:03	04:20	04:33

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	35.50	33.50
8		36.50	33.25
Flap		36.00	35.25
Time:	04:07	04:16	04:38

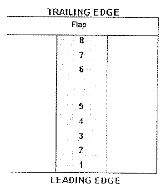
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	50	96	3
3			
4			
5	66	134	6
6			
7			
8	55	104	6
Flap	22	135	3
Time:	04:00	04:15	04:37

Wing and Plate Condition After the Takeoff Run
Time: ____________

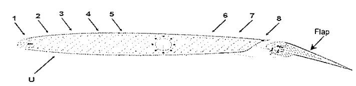


Comments:________________

Wing and Plate Condition Before 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: ____________
ASSISTED BY: ____________

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Figure C71: Test #142

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013

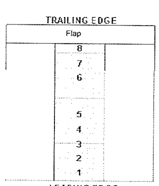
Run: 143 (P934)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-22.3	/	/
T5		-22.5		
TU		-22.3		
Time:		04:44		

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	/	/
8			
Flap			
Time:	04:47		

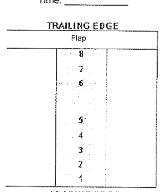
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	/
2	35		
3			
4			
5	70		
6			
7			
8	65		
Flap	20		
Time:	04:47		

Wing and Plate Condition After the Takeoff Run
Time: ____________

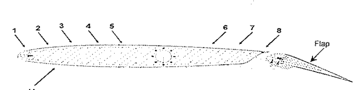


Comments:________________

Wing and Plate Condition Before 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: DJ / VB
ASSISTED BY: ____________

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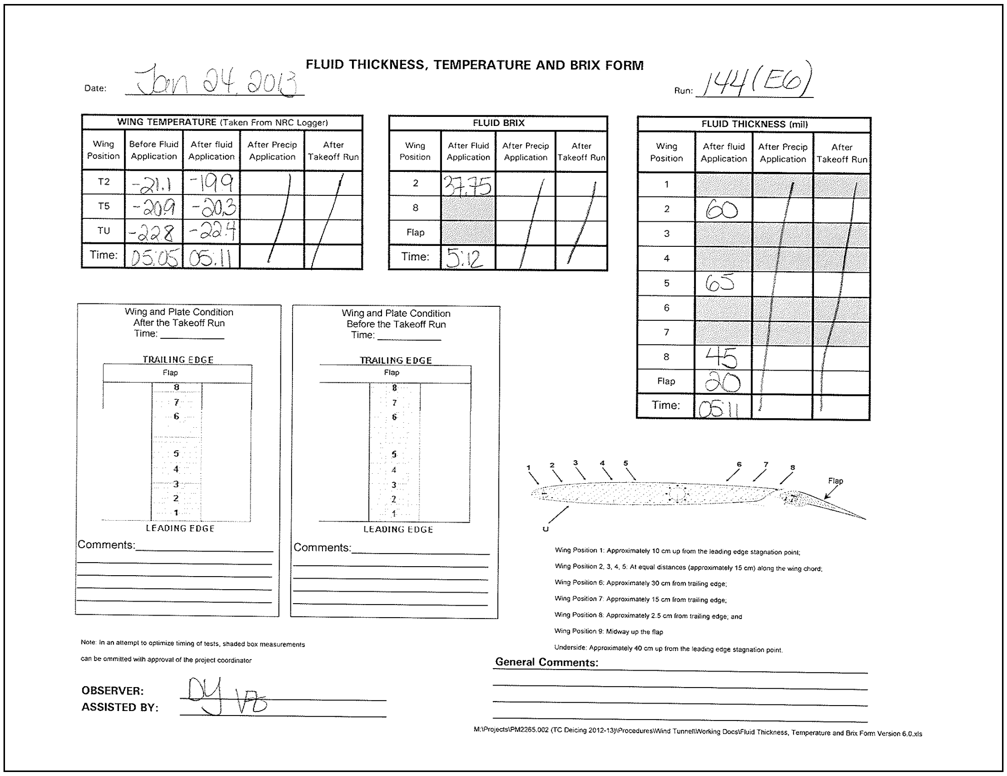
Figure C72: Test #143



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013 Run: 144(E6)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-21.1	-19.9	/	/
T5	-20.9	-20.3	/	/
TU	-22.8	-22.4	/	/
Time:	05:05	05:11	/	/

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	/	/
8		/	/
Flap		/	/
Time:	5:12	/	/

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	/
2	60	/	/
3		/	/
4		/	/
5	65	/	/
6		/	/
7		/	/
8	45	/	/
Flap	20	/	/
Time:	05:11	/	/

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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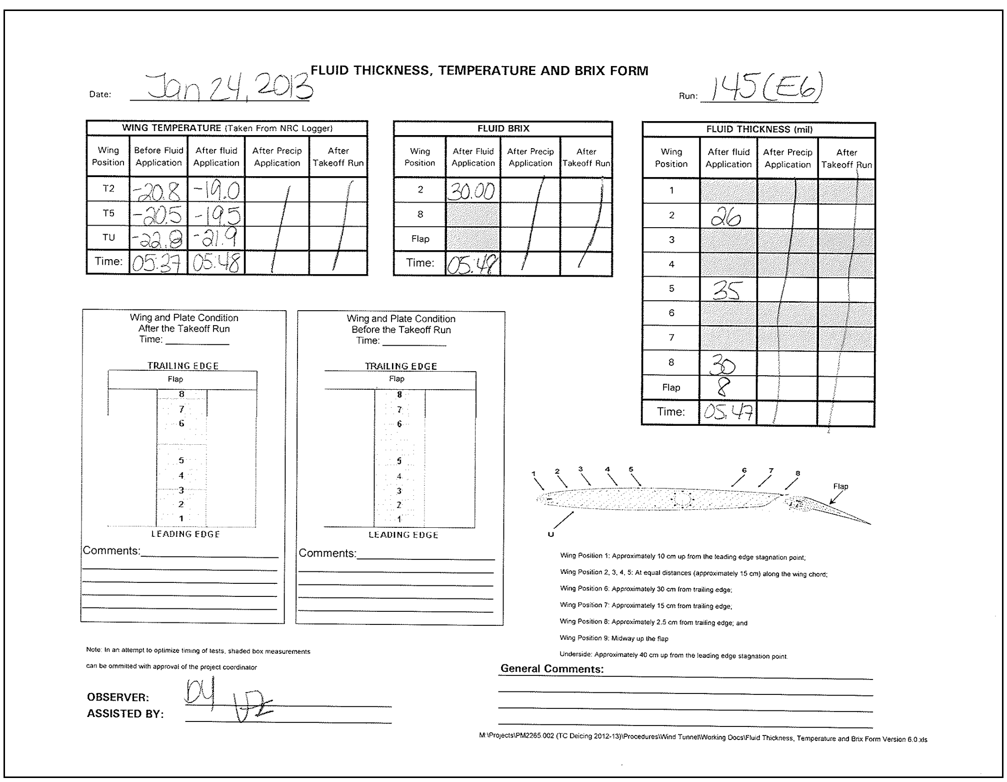
Figure C73: Test #144



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013 Run: 145(E6)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-20.8	-19.0	/	/
T5	-20.5	-19.5	/	/
TU	-22.8	-21.9	/	/
Time:	05:37	05:48	/	/

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	30.00	/	/
8		/	/
Flap		/	/
Time:	05:48	/	/

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	/
2	26	/	/
3		/	/
4		/	/
5	35	/	/
6		/	/
7		/	/
8	30	/	/
Flap	8	/	/
Time:	05:47	/	/

Wing and Plate Condition After the Takeoff Run
Time: ______

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

Comments: ______

Wing and Plate Condition Before 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.

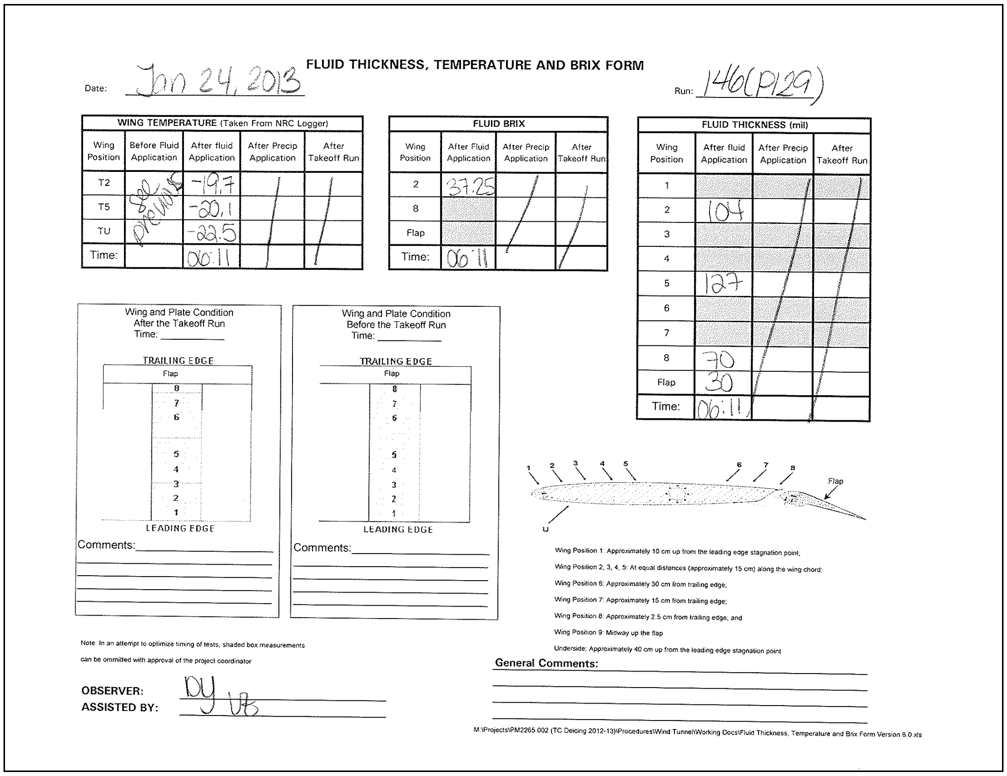
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______

OBSERVER: DY
ASSISTED BY: VB

M:\Projects\PM2265.002 (TC Deicing 2012-13)\Procedures\Wind Tunnel\Working Docs\Fluid Thickness, Temperature and Brix Form Version 6.0.xls

Figure C74: Test #145



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013 Run: 146(P129)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-19.7	/	/
T5		-20.1	/	/
TU		-22.5	/	/
Time:		06:11	/	/

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	/	/
8		/	/
Flap		/	/
Time:	06:11	/	/

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			/
2	104	/	/
3		/	/
4		/	/
5	127	/	/
6		/	/
7		/	/
8	70	/	/
Flap	30	/	/
Time:	06:11	/	/

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: JB

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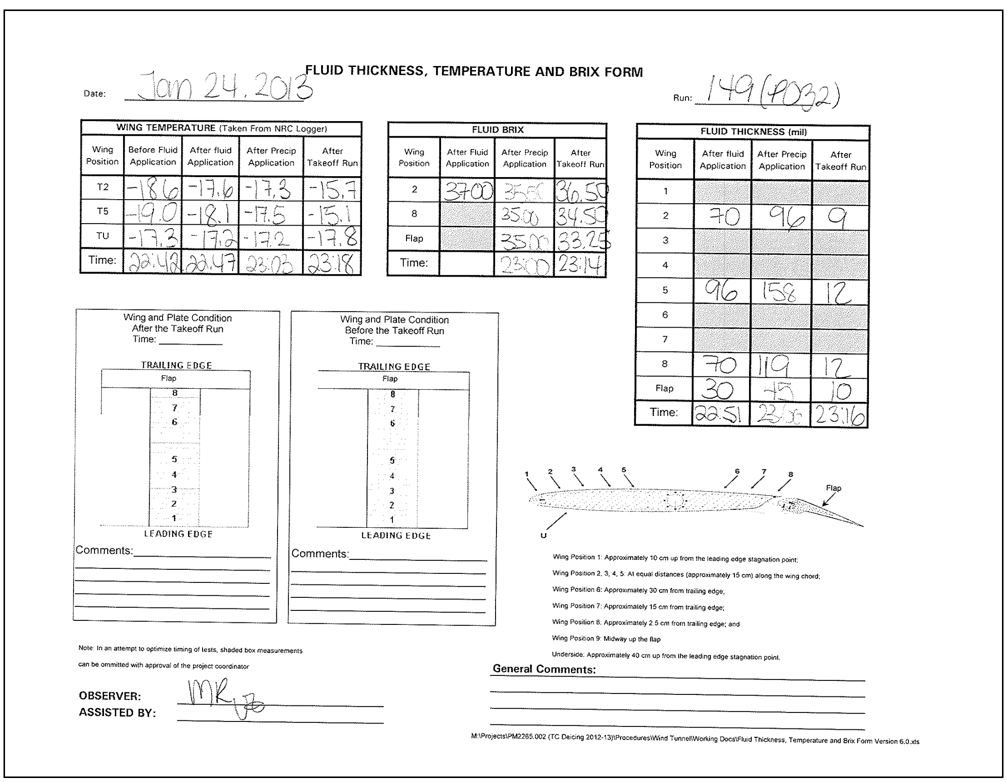
Figure C75: Test #146



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013 Run: 149(P032)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-18.6	-17.6	-17.3	-15.7
T5	-19.0	-18.1	-17.5	-15.1
TU	-17.3	-17.2	-17.2	-17.8
Time:	22:48	22:47	23:03	23:18

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	35.50	36.50
8		35.00	34.50
Flap		35.00	33.25
Time:		23:00	23:14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	70	96	9
3			
4			
5	96	158	12
6			
7			
8	70	119	12
Flap	30	45	10
Time:	22:51	23:06	23:16

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: MR
ASSISTED BY: JB

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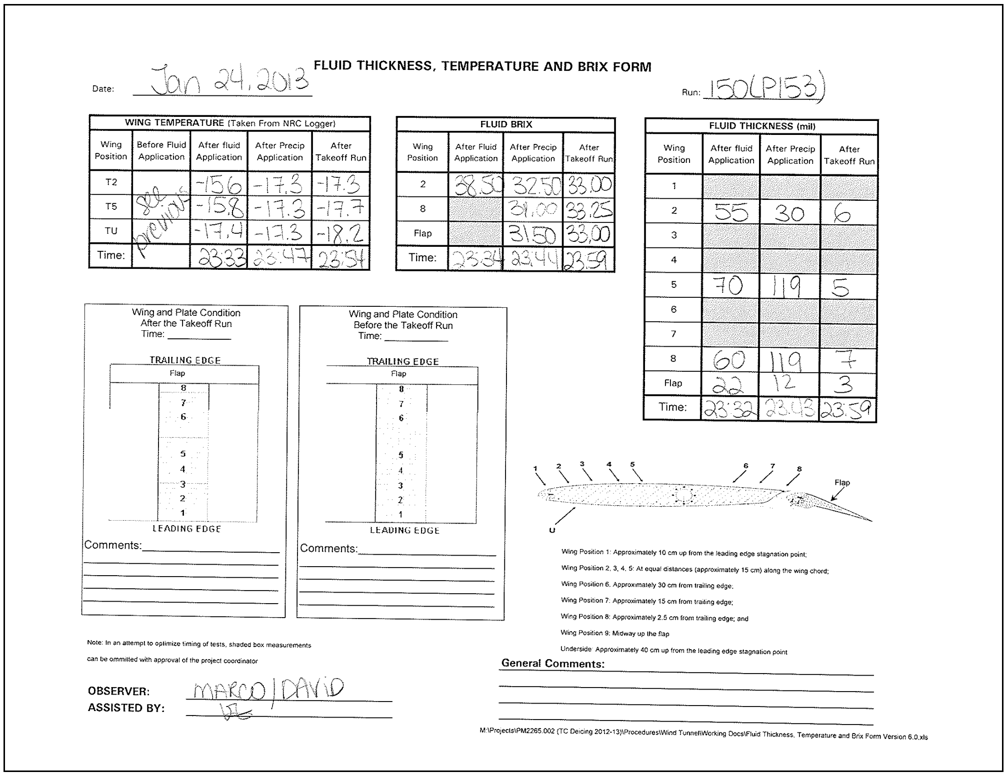
Figure C76: Test #149



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 24, 2013

Run: 150(P153)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-15.6	-17.3	-17.3
T5		-15.8	-17.3	-17.7
TU		-17.4	-17.3	-18.2
Time:		23:33	23:47	23:54

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.50	32.50	33.00
8		31.00	33.25
Flap		31.50	33.00
Time:	23:34	23:44	23:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	30	6
3			
4			
5	70	119	5
6			
7			
8	60	119	7
Flap	22	12	3
Time:	23:32	23:43	23:59

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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 ommited with approval of the project coordinator

General Comments:

OBSERVER: MARCO/DAVID
ASSISTED BY: VL

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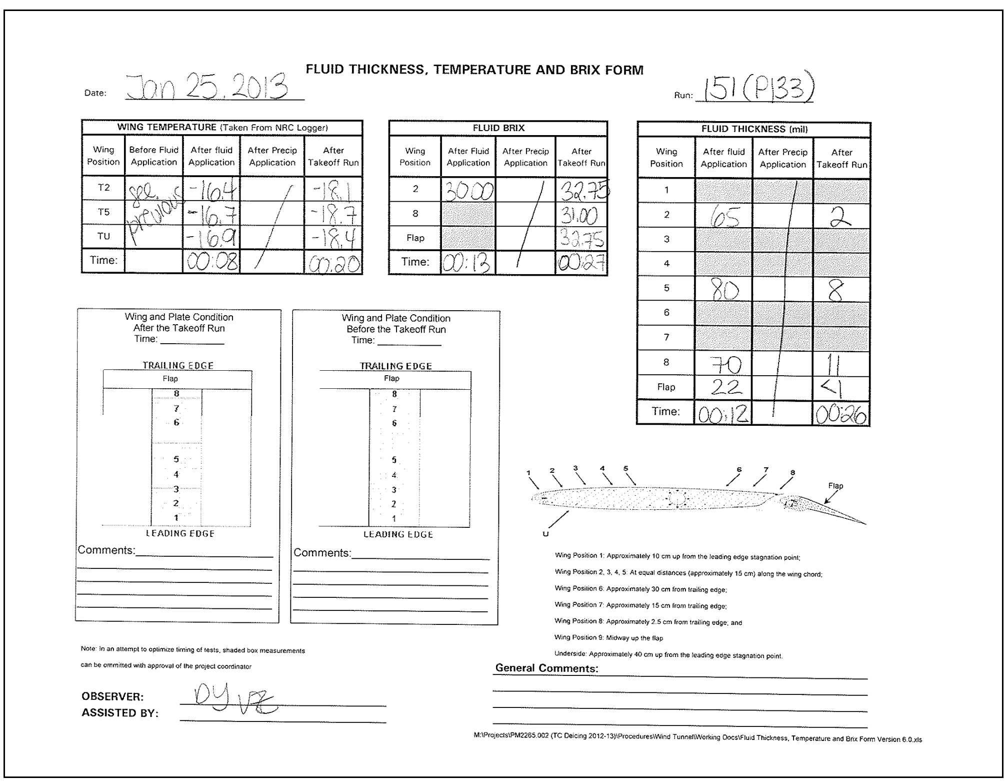
Figure C77: Test #150



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 151(P133)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-16.4	/	-18.1
T5		-16.7	/	-18.7
TU		-16.9	/	-18.4
Time:		00:08	/	00:20

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	30.00	/	32.75
8		/	31.00
Flap		/	32.75
Time:	00:13	/	00:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	65	/	2
3		/	
4		/	
5	80	/	8
6		/	
7		/	
8	70	/	11
Flap	22	/	<1
Time:	00:12	/	00:26

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments:

Wing and Plate Condition Before 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 ommited with approval of the project coordinator

General Comments:

OBSERVER: DY VL
ASSISTED BY:

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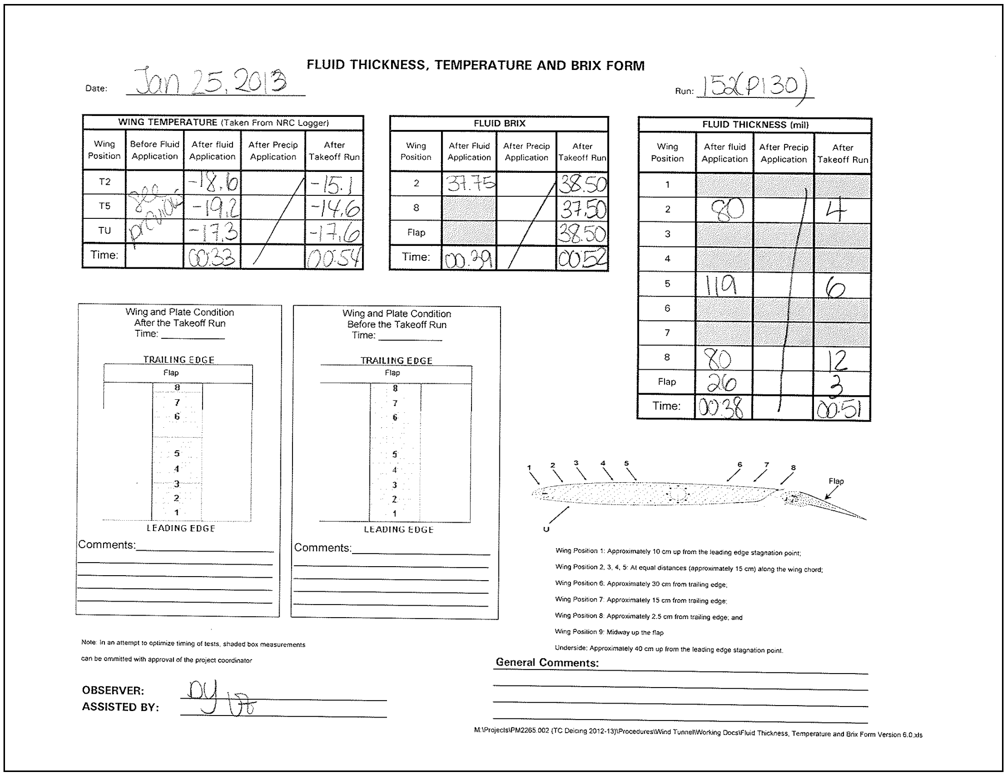
Figure C78: Test #151



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 152(P130)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-18.6	/	-15.1
T5		-19.2	/	-14.6
TU		-17.3	/	-17.6
Time:		00:33	/	00:54

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	/	38.50
8		/	37.50
Flap		/	38.50
Time:	00:29	/	00:52

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	80	/	4
3		/	
4		/	
5	119	/	6
6		/	
7		/	
8	80	/	12
Flap	26	/	3
Time:	00:38	/	00:51

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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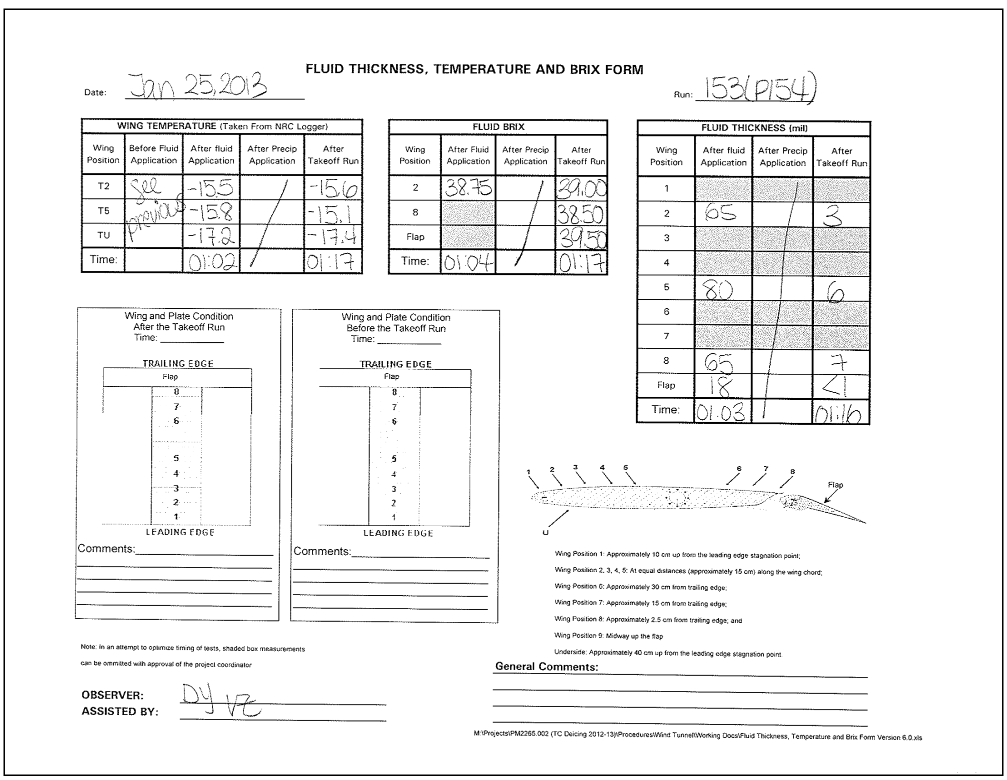
Figure C79: Test #152



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 153(P154)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-15.5	/	-15.6
T5		-15.8	/	-15.1
TU		-17.2	/	-17.4
Time:		01:02	/	01:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.75	/	39.00
8		/	38.50
Flap		/	39.50
Time:	01:04	/	01:17

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	65	/	3
3		/	
4		/	
5	80	/	6
6		/	
7		/	
8	65	/	7
Flap	18	/	<1
Time:	01:03	/	01:16

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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.

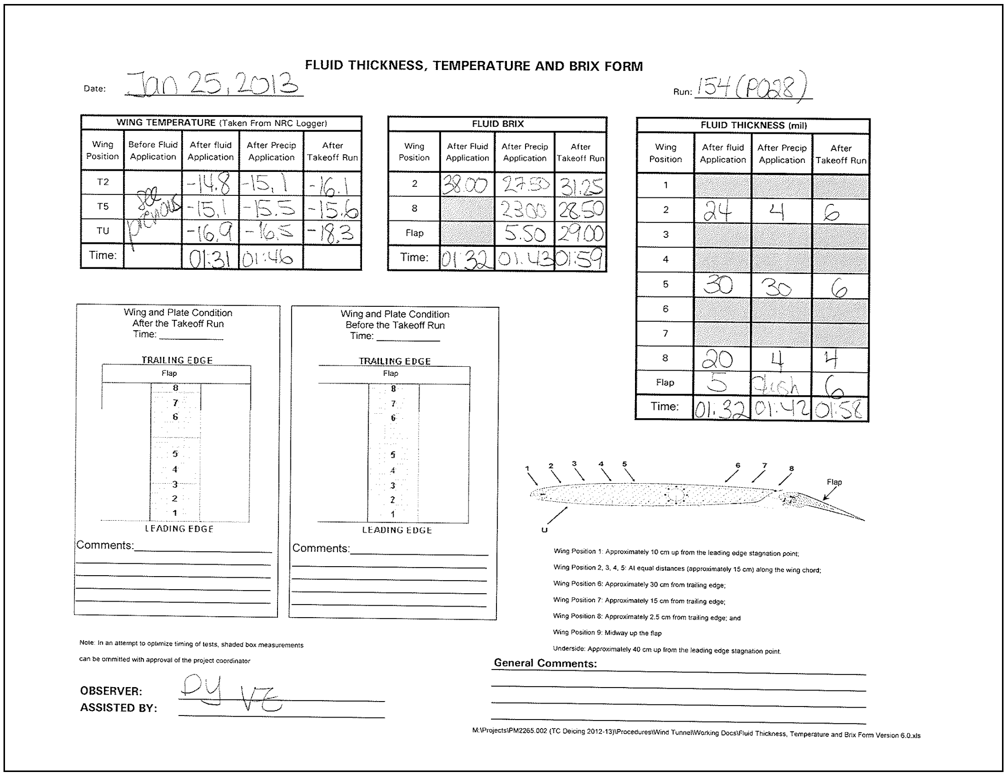
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______

OBSERVER: DY
ASSISTED BY: VC

M:\Projects\PM2265.002 (TC Deicing 2012-13)\Procedures\Wind Tunnel\Working Docs\Fluid Thickness, Temperature and Brix Form Version 6.0.xls

Figure C80: Test #153



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 154 (P028)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-14.8	-15.1	-16.1
T5		-15.1	-15.5	-15.6
TU		-16.9	-16.5	-18.3
Time:		01:31	01:46	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.00	27.50	31.25
8		23.00	28.50
Flap		5.50	29.00
Time:	01:32	01:43	01:59

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	24	4	6
3			
4			
5	30	30	6
6			
7			
8	20	4	4
Flap	5	flush	6
Time:	01:32	01:42	01:58

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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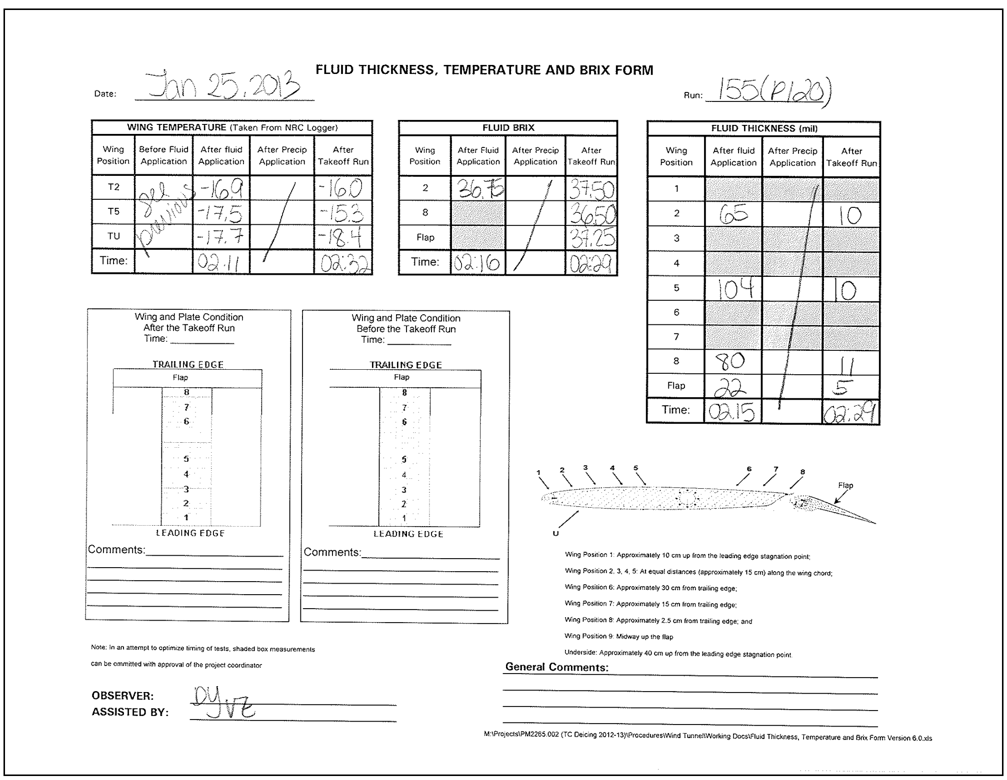
Figure C81: Test #154



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 155 (P120)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-16.9	/	-16.0
T5		-17.5		-15.3
TU		-17.7		-18.4
Time:		02:11		02:32

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.75	/	37.50
8			36.50
Flap			37.25
Time:	02:16		02:29

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	65		10
3			
4			
5	104		10
6			
7			
8	80		11
Flap	22		5
Time:	02:15		02:29

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: JVZ

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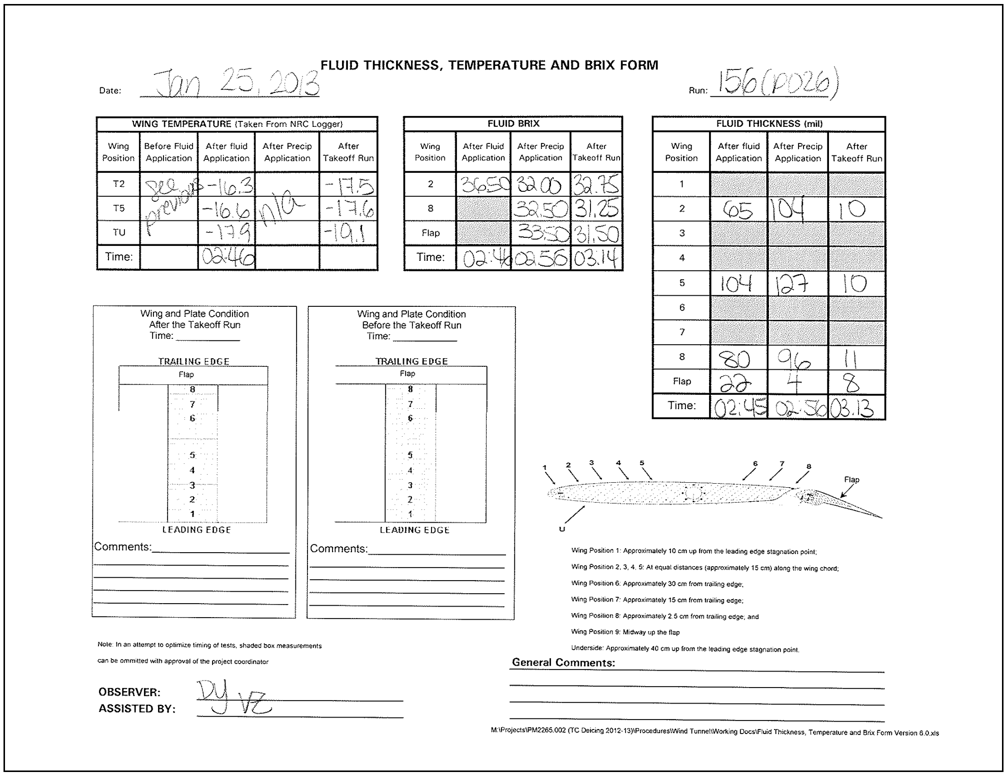
Figure C82: Test #155



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 156(P026)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-16.3	n/a	-17.5
T5		-16.6		-17.6
TU		-17.9		-19.1
Time:		02:46		

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	32.00	32.75
8		32.50	31.25
Flap		33.50	31.50
Time:	02:46	02:56	03.14

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	104	10
3			
4			
5	104	127	10
6			
7			
8	80	96	11
Flap	22	4	8
Time:	02:45	02:56	03.13

Wing and Plate Condition After the Takeoff Run Time: ________
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ________

Wing and Plate Condition Before 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.

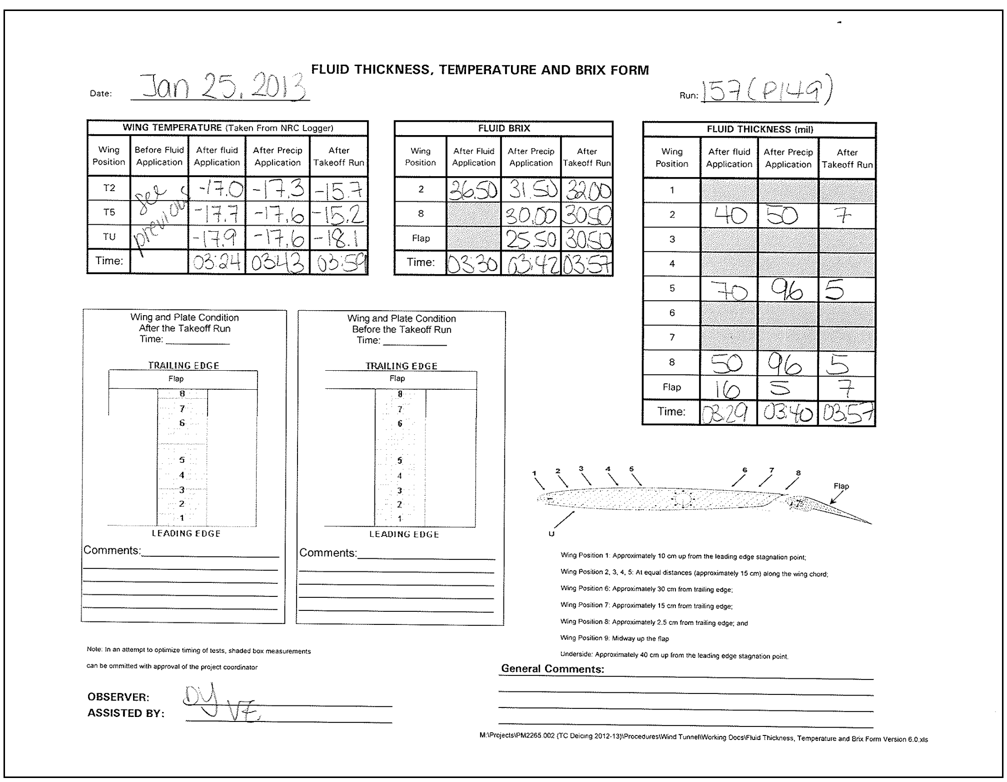
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ________

OBSERVER: DY
ASSISTED BY: VZ

M:\Projects\PM2265.002 (TC Deicing 2012-13)\Procedures\Wind Tunnel\Working Docs\Fluid Thickness, Temperature and Brix Form Version 6.0.xls

Figure C83: Test #156



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013

Run: 157(P149)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-17.0	-17.3	-15.7
T5		-17.7	-17.6	-15.2
TU		-17.9	-17.6	-18.1
Time:		03:24	03:43	03:59

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	31.50	32.00
8		30.00	30.50
Flap		25.50	30.50
Time:	03:30	03:42	03:57

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	40	50	7
3			
4			
5	70	96	5
6			
7			
8	50	96	5
Flap	16	5	7
Time:	03:29	03:40	03:57

Wing and Plate Condition After the Takeoff Run Time: ________
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ________

Wing and Plate Condition Before 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: DY
ASSISTED BY: VZ

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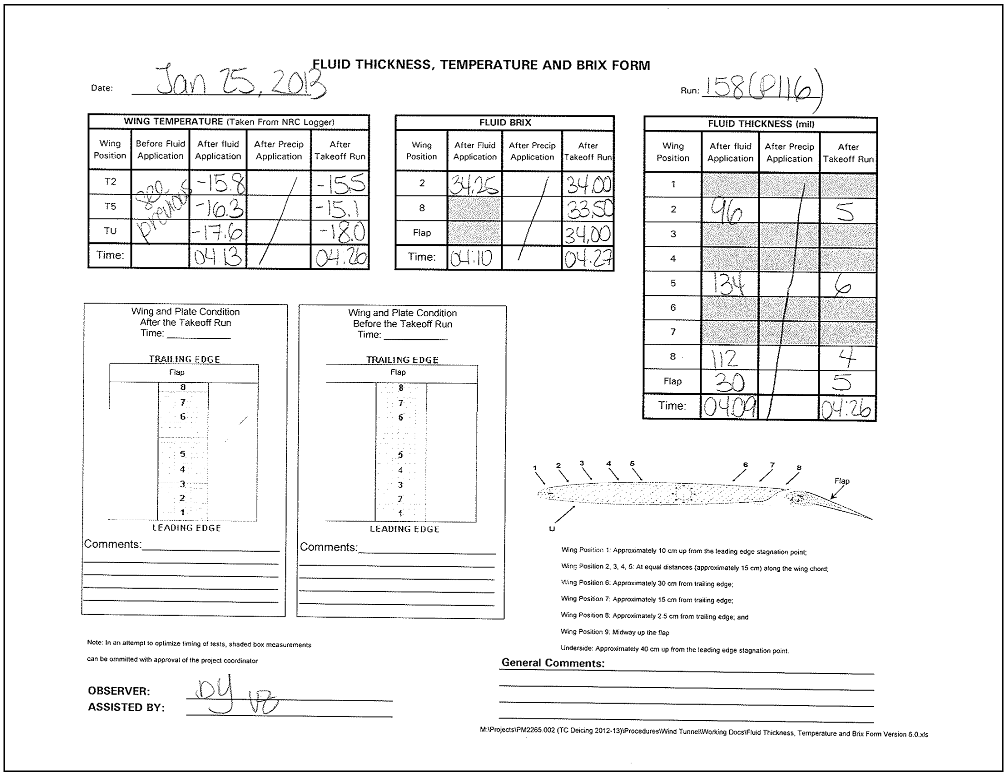
Figure C84: Test #157



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013 Run: 158(P116)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-15.8	/	-15.5
T5		-16.3		-15.1
TU		-17.6		-18.0
Time:		04:13	/	04:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.25	/	34.00
8			33.50
Flap			34.00
Time:	04:10	/	04:27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	96		5
3			
4			
5	134		6
6			
7			
8	112		4
Flap	30		5
Time:	04:09	/	04:26

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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.

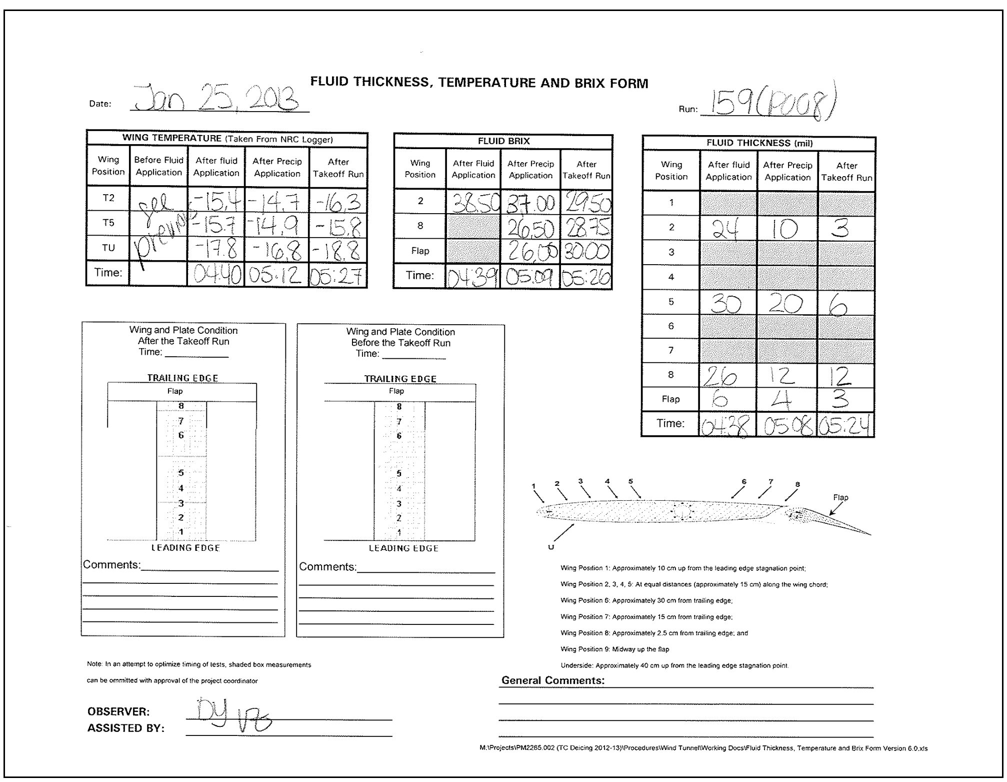
Note: In an attempt to optimize timing of tests, shaded box measurements can be ommitted with approval of the project coordinator

General Comments: ______

OBSERVER: DY
ASSISTED BY: VB

M:\Projects\PM2265.002 (TC Deicing 2012-13)\Procedures\Wind Tunnel\Working Docs\Fluid Thickness, Temperature and Brix Form Version 6.0.xls

Figure C85: Test #158



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013 Run: 159(P008)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-15.4	-14.7	-16.3
T5		-15.7	-14.9	-15.8
TU		-17.8	-16.8	-18.8
Time:		04:40	05:12	05:27

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	37.00	29.50
8		26.50	28.75
Flap		26.00	30.00
Time:	04:39	05:09	05:26

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	24	10	3
3			
4			
5	30	20	6
6			
7			
8	26	12	12
Flap	6	4	3
Time:	04:38	05:08	05:24

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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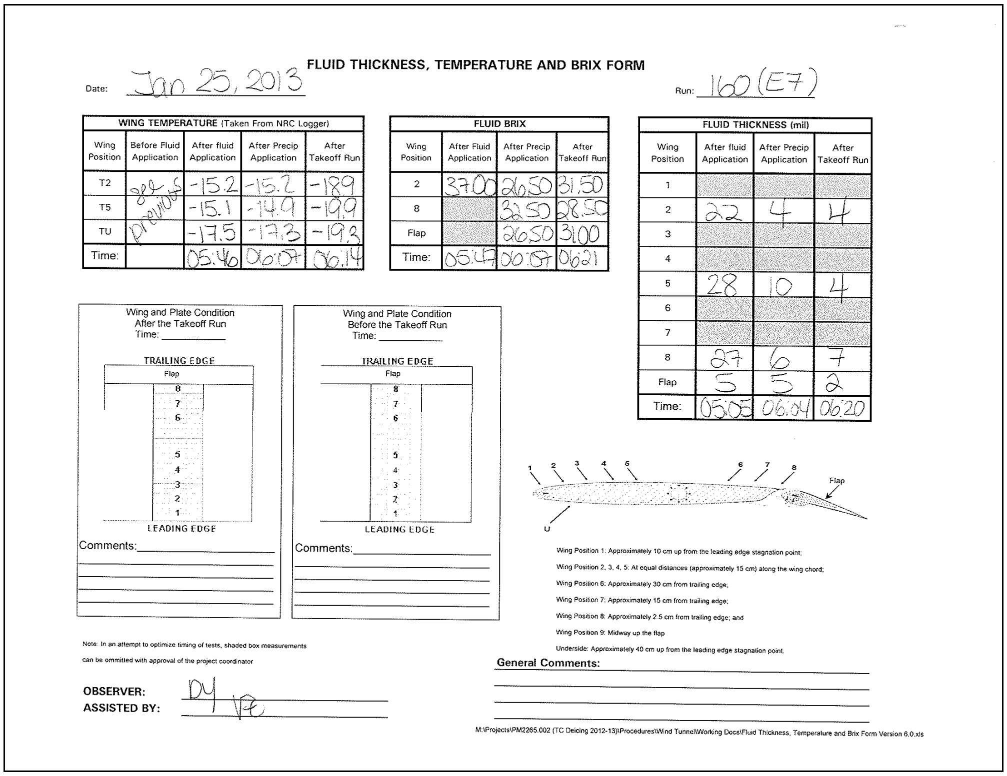
Figure C86: Test #159



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 25, 2013 Run: 160 (E7)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-15.2	-15.2	-18.9
T5		-15.1	-14.9	-19.9
TU		-17.5	-17.3	-19.3
Time:		05:46	06:07	06:14

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	26.50	31.50
8		32.50	28.50
Flap		26.50	31.00
Time:	05:47	06:07	06:21

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	22	4	4
3			
4			
5	28	10	4
6			
7			
8	27	6	7
Flap	5	5	2
Time:	05:05	06:04	06:20

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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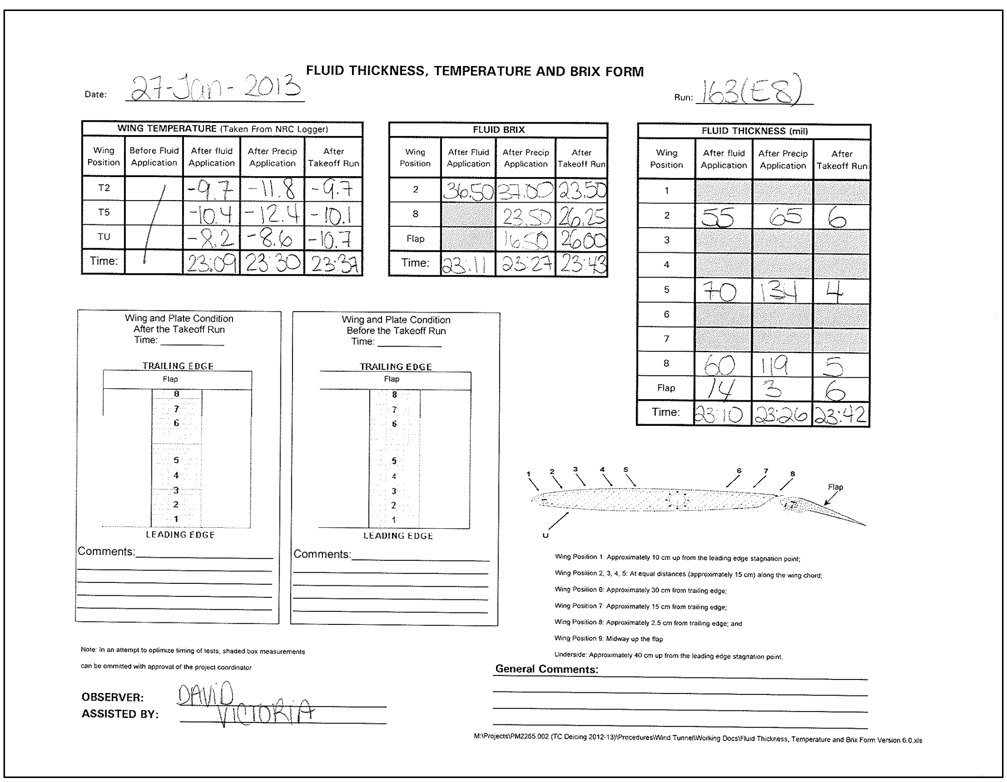
Figure C87: Test #160



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: 27-Jan-2013 Run: 163(E8)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	/	-9.7	-11.8	-9.7
T5		-10.4	-12.4	-10.1
TU		-8.2	-8.6	-10.7
Time:		23:09	23:30	23:37

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	37.00	23.50
8		23.50	26.25
Flap		16.50	26.00
Time:	23:11	23:27	23:43

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	65	6
3			
4			
5	70	134	4
6			
7			
8	60	119	5
Flap	14	3	6
Time:	23:10	23:26	23:42

Wing and Plate Condition After the Takeoff Run
Time: ________

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

Comments:

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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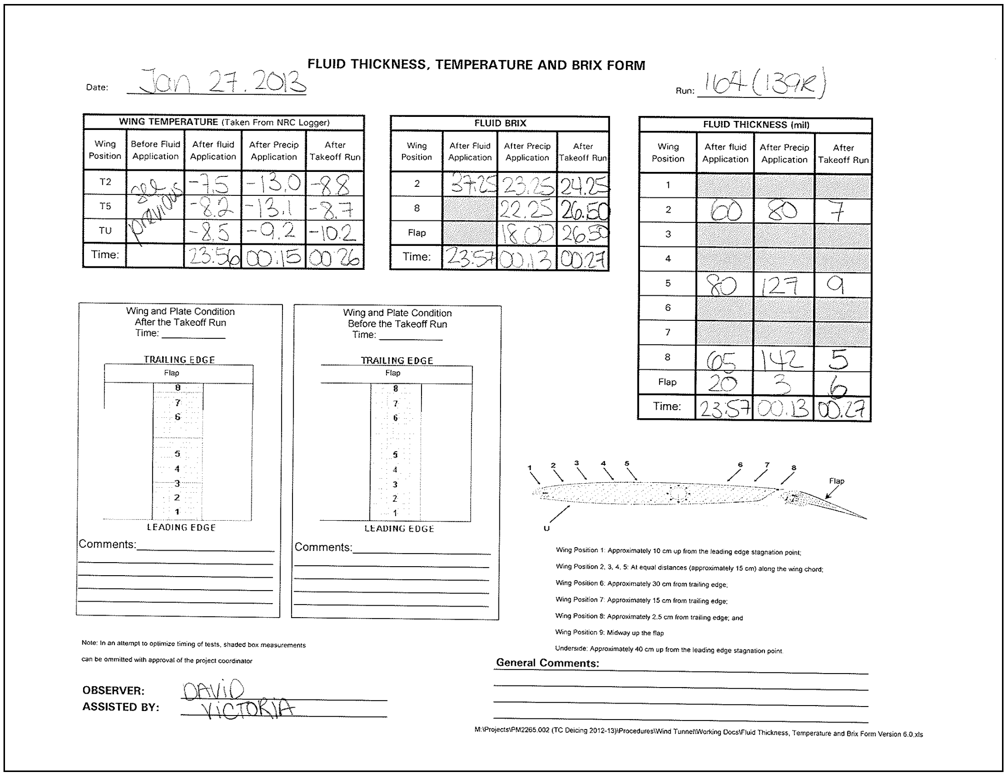
Figure C88: Test #163



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 27. 2013 Run: 164 (139R)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-7.5	-13.0	-8.8
T5		-8.2	-13.1	-8.7
TU		-8.5	-9.2	-10.2
Time:		23:56	00:15	00:26

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	23.25	24.25
8		22.25	26.50
Flap		18.00	26.50
Time:	23:57	00.13	00.27

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	80	7
3			
4			
5	80	127	9
6			
7			
8	65	142	5
Flap	20	3	6
Time:	23:57	00.13	00.27

Wing and Plate Condition After the Takeoff Run Time: ______
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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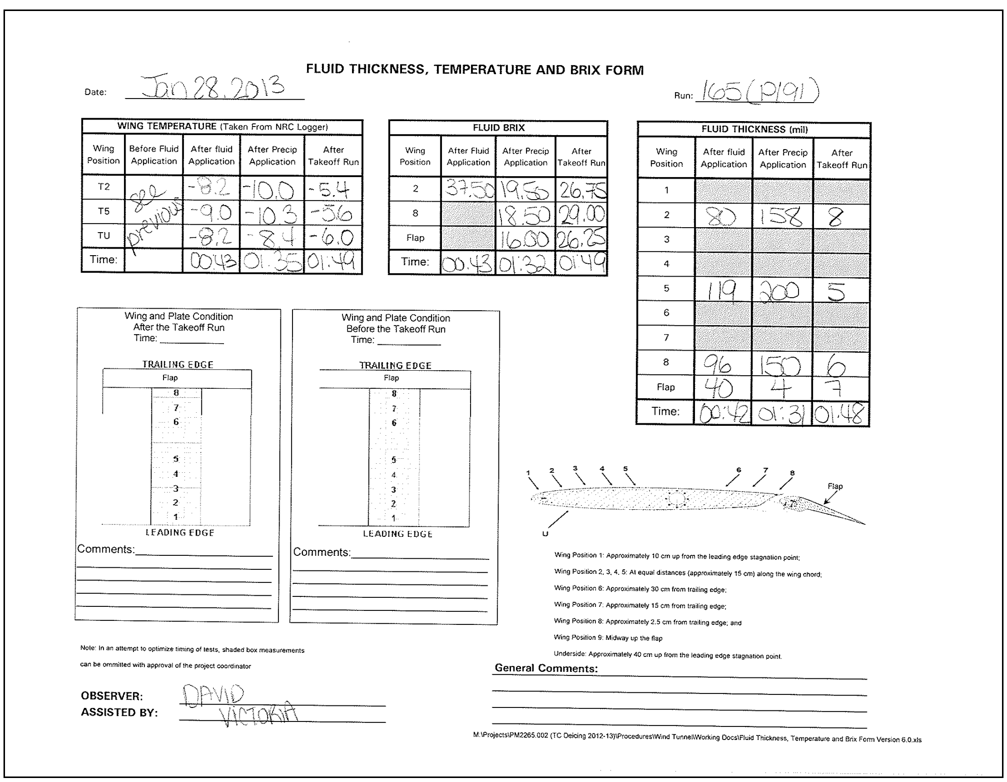
Figure C89: Test #164



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28. 2013 Run: 165 (P191)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-8.2	-10.0	-5.4
T5		-9.0	-10.3	-5.6
TU		-8.2	-8.4	-6.0
Time:		00:43	01:35	01:49

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	19.50	26.75
8		18.50	29.00
Flap		16.00	26.25
Time:	00.43	01:32	01:49

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	158	8
3			
4			
5	119	200	5
6			
7			
8	96	150	6
Flap	40	4	7
Time:	00:42	01:31	01:48

Wing and Plate Condition After the Takeoff Run Time: ______
TRAILING EDGE / Flap / 8 7 6 5 4 3 2 1 / LEADING EDGE
Comments: ______

Wing and Plate Condition Before 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: DAVID
ASSISTED BY: VICTORIA

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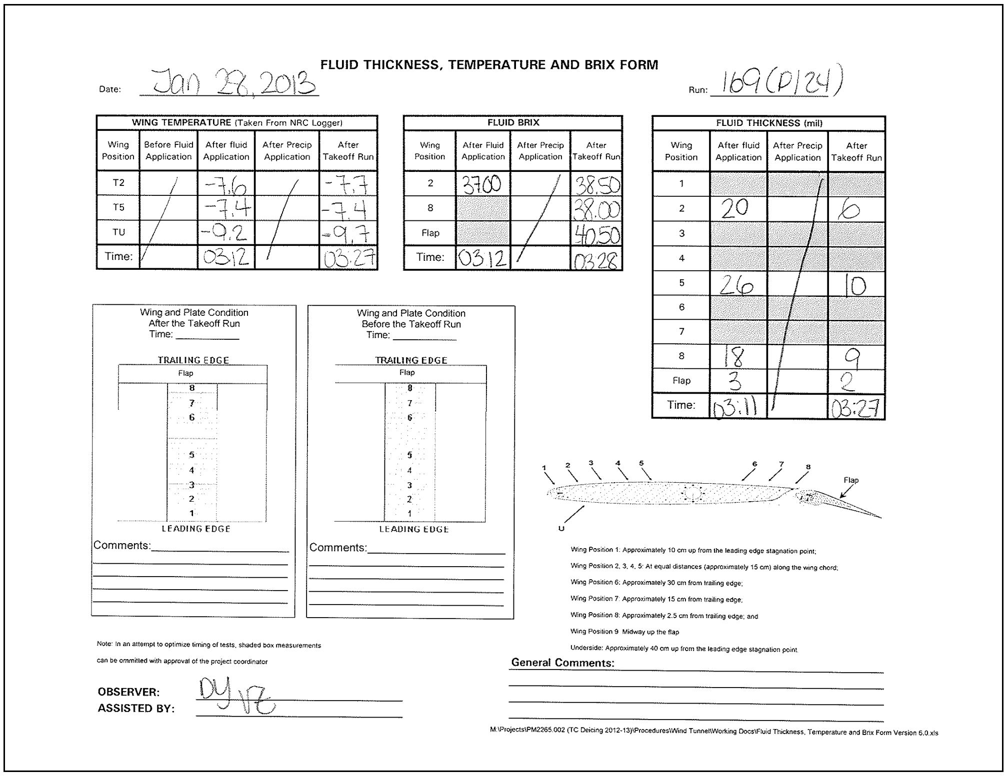
Figure C90: Test #165



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013

Run: 169 (P124)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	/	-7.6	/	-7.7
T5	/	-7.4	/	-7.4
TU	/	-9.2	/	-9.7
Time:	/	03:12	/	03:27

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	/	38.50
8		/	38.00
Flap		/	40.50
Time:	03:12	/	03:28

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	20	/	6
3		/	
4		/	
5	26	/	10
6		/	
7		/	
8	18	/	9
Flap	3	/	2
Time:	03:11	/	03:27

Wing and Plate Condition After the Takeoff Run Time: ______

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

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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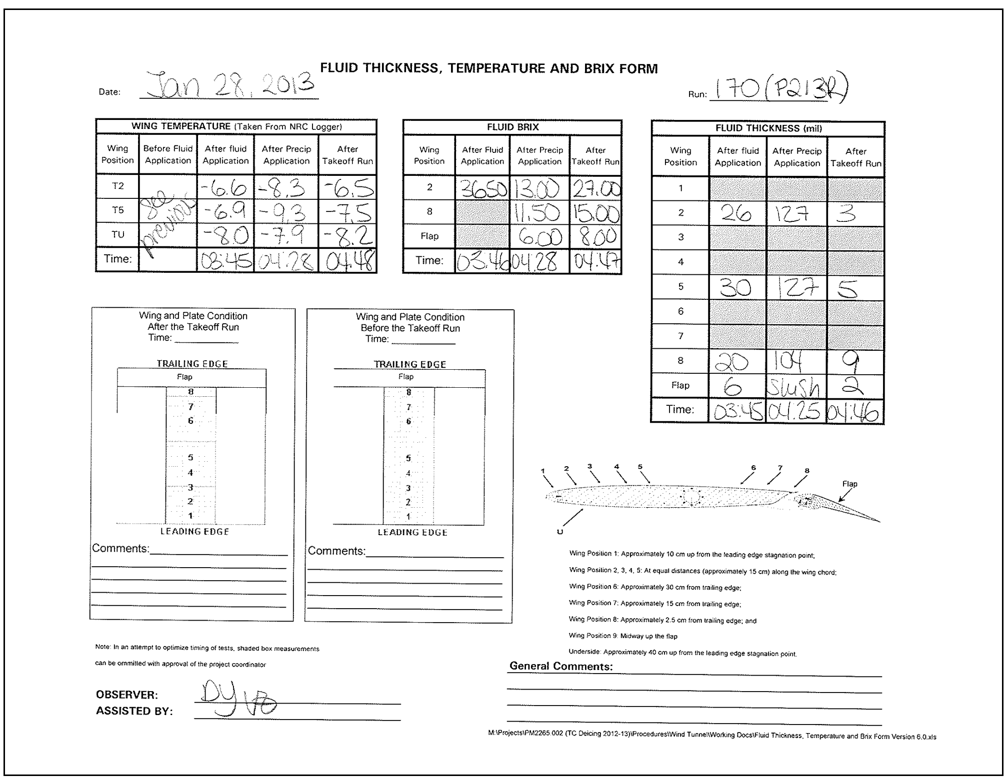
Figure C91: Test #169



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013

Run: 170 (P213R)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-6.6	-8.3	-6.5
T5		-6.9	-9.3	-7.5
TU		-8.0	-7.9	-8.2
Time:		03:45	04:28	04:48

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	13.00	27.00
8		11.50	15.00
Flap		6.00	8.00
Time:	03:46	04:28	04:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	26	127	3
3			
4			
5	30	127	5
6			
7			
8	20	104	9
Flap	6	slush	2
Time:	03:45	04:25	04:46

Wing and Plate Condition After the Takeoff Run Time: ______

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

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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Figure C92: Test #170

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013

Run: 171 (P213R)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-7.3	-8.5	-9.6	-6.9
T5	-7.9	-9.6	-10.3	-7.3
TU	-8.2	-8.3	-8.8	-9.2
Time:	04:57	0503	06:33	0550

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	17.50	23.25
8		17.50	20.00
Flap		12.00	24.00
Time:	5:07	06:31	05:49

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	30	64	3
3			
4			
5	40	104	4
6			
7			
8	24	64	3
Flap	7	Slush	3
Time:	5:06	06:31	05:49

Wing and Plate Condition After the Takeoff Run
Time: ________

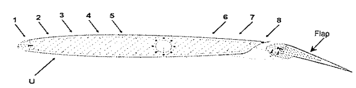
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments: ________

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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Figure C93: Test #171

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013

Run: 172 (P143R)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-6.5	-8.0	-10.5	-8.0
T5	-6.9	-8.7	-11.1	-7.8
TU	-9.1	-9.1	-8.2	-9.8
Time:	05:54	06:08	06:35	06:48

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.25	18.00	33.75
8		20.00	19.50
Flap		15.00	29.00
Time:	06:09	06:32	06:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	40	80	1
3			
4			
5	65	119	3
6			
7			
8	45	96	4
Flap	11	10	6
Time:	06:07	06:32	06:46

Wing and Plate Condition After the Takeoff Run
Time: ________

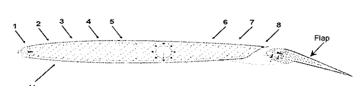
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE

Comments: ________

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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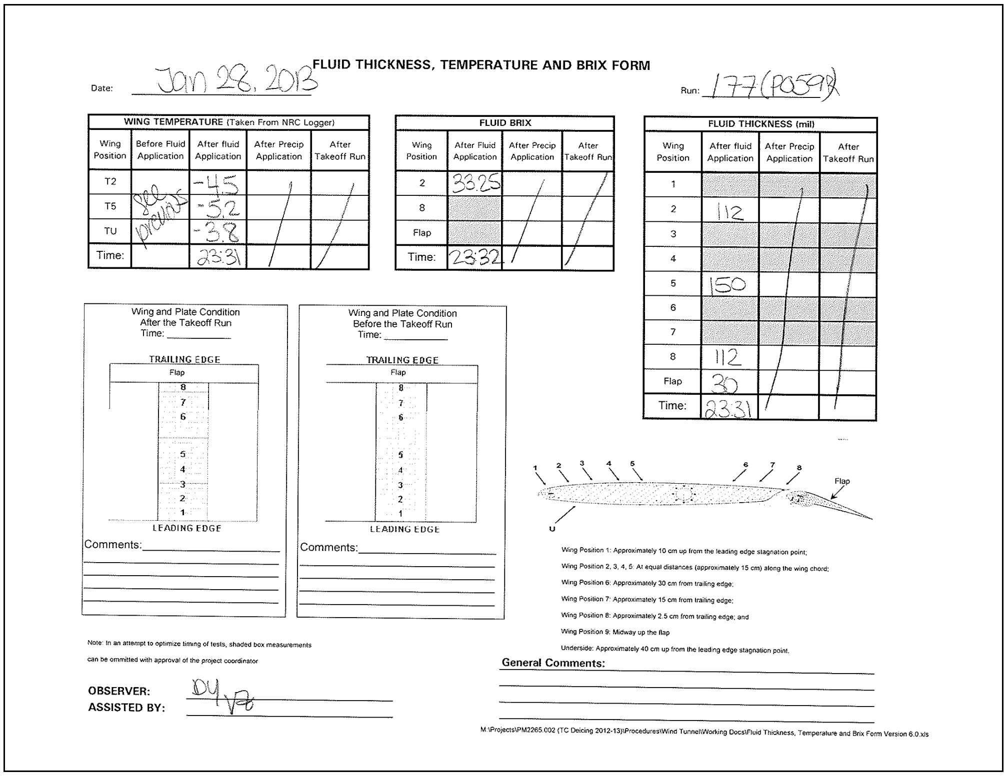
Figure C94: Test #172



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013 Run: 177(P059B)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-4.5	/	/
T5		-5.2	/	/
TU		-3.8	/	/
Time:		23:31	/	/

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.25	/	/
8			
Flap			
Time:	23:32	/	/

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	/
2	112		
3			
4			
5	150		
6			
7			
8	112		
Flap	30		
Time:	23:31	/	/

Wing and Plate Condition After the Takeoff Run Time: ______

Wing and Plate Condition Before 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: DY, VB
ASSISTED BY: ______

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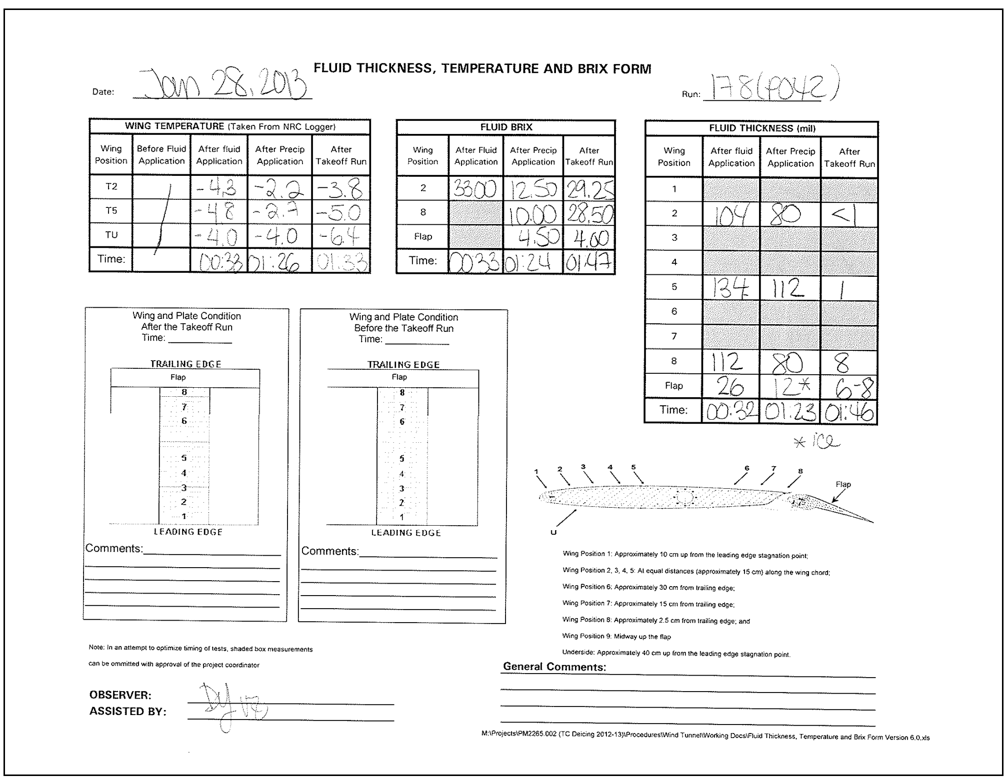
Figure C95: Test #177



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 28, 2013 Run: 178(P042)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	/	-4.3	-2.2	-3.8
T5		-4.8	-2.7	-5.0
TU		-4.0	-4.0	-6.4
Time:		00:33	01:26	01:33

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.00	12.50	29.25
8		10.00	28.50
Flap		4.50	4.60
Time:	00:33	01:24	01:47

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	104	80	<1
3			
4			
5	134	112	1
6			
7			
8	112	80	8
Flap	26	12*	6-8
Time:	00:32	01:23	01:46

*ice

Wing and Plate Condition After the Takeoff Run Time: ______

Wing and Plate Condition Before 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: DY, VB
ASSISTED BY: ______

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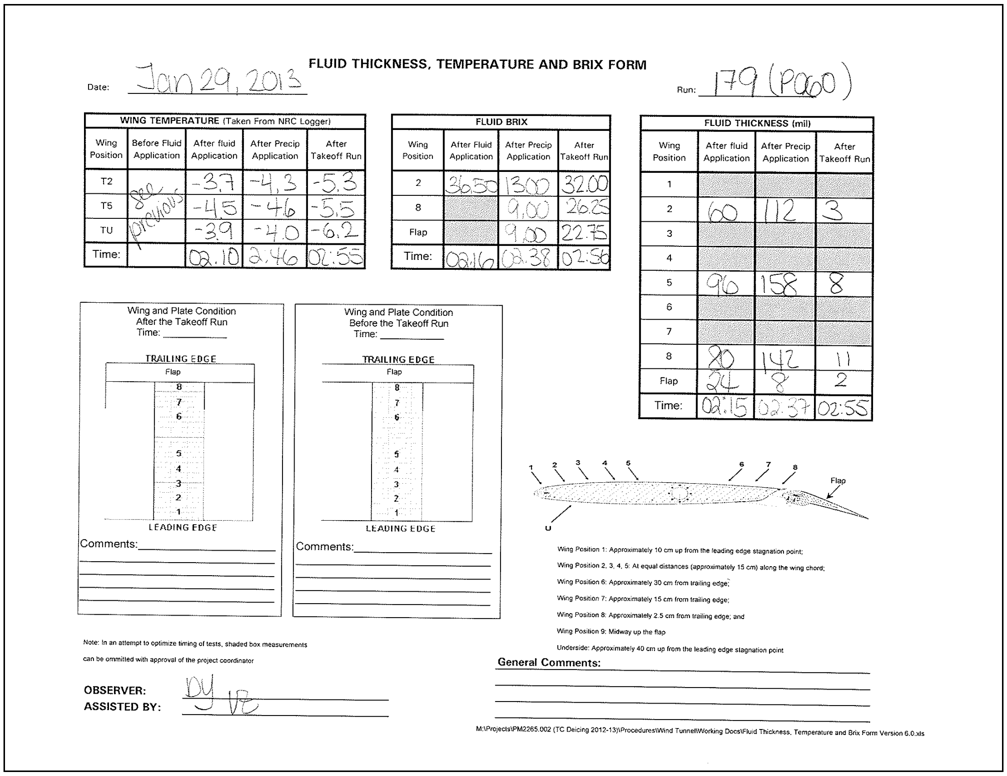
Figure C96: Test #173



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 29, 2013   Run: 179 (P060)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-3.7	-4.3	-5.3
T5		-4.5	-4.6	-5.5
TU		-3.9	-4.0	-6.2
Time:		02:10	2:46	02:55

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	13.00	32.00
8		9.00	26.25
Flap		9.00	22.75
Time:	02:16	02:38	02:56

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	60	112	3
3			
4			
5	96	158	8
6			
7			
8	80	142	11
Flap	24	8	2
Time:	02:15	02:37	02:55

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments: ____

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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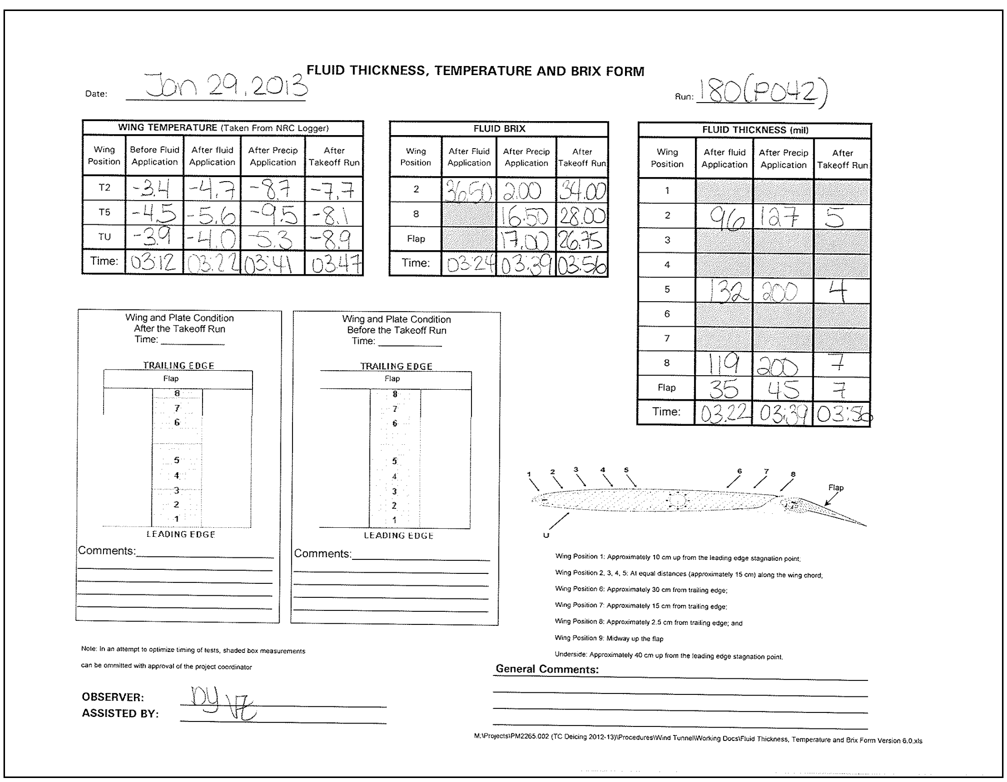
Figure C97: Test #179



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 29, 2013   Run: 180 (P042)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-3.4	-4.7	-8.7	-7.7
T5	-4.5	-5.6	-9.5	-8.1
TU	-3.9	-4.0	-5.3	-8.9
Time:	03:12	03:22	03:41	03:47

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	36.50	2.00	34.00
8		16.50	28.00
Flap		17.00	26.75
Time:	03:24	03:39	03:56

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	127	5
3			
4			
5	132	200	4
6			
7			
8	119	200	7
Flap	35	45	7
Time:	03:22	03:39	03:56

Wing and Plate Condition After the Takeoff Run Time: ____

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

Comments: ____

Wing and Plate Condition Before 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: DY VB
ASSISTED BY:

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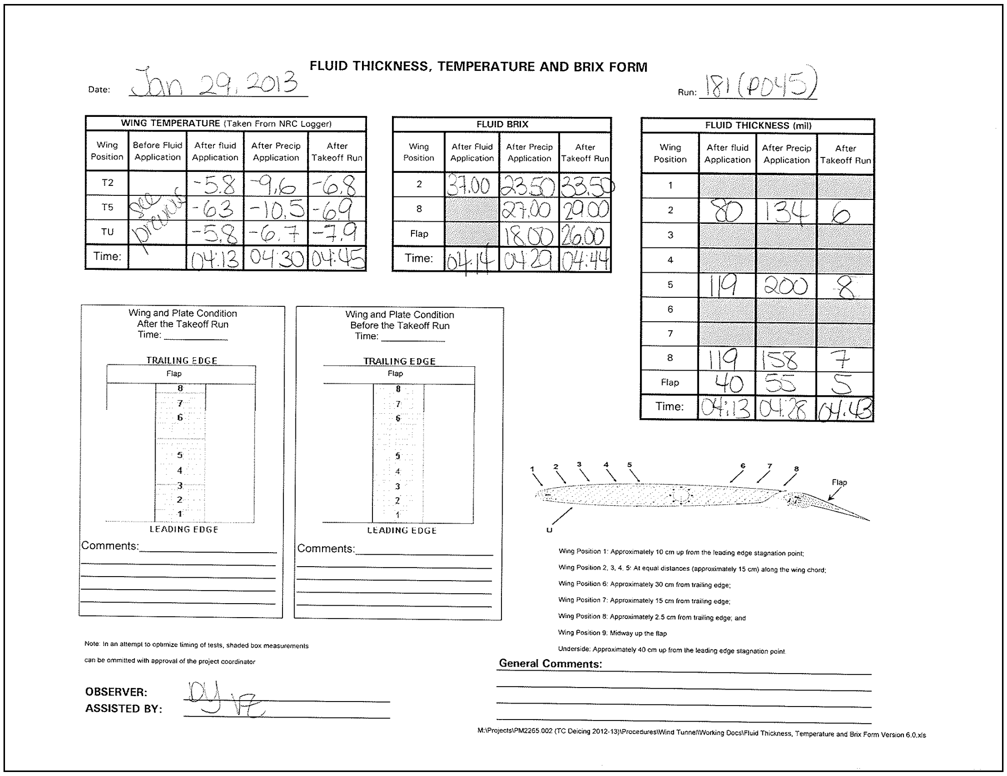
Figure C98: Test #180



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 29, 2013

Run: 181 (P045)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-5.8	-9.6	-6.8
T5		-6.3	-10.5	-6.9
TU		-5.8	-6.7	-7.9
Time:		04:13	04:30	04:45

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	23.50	33.50
8		27.00	29.00
Flap		18.00	26.00
Time:	04:14	04:29	04:44

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	80	134	6
3			
4			
5	119	200	8
6			
7			
8	119	158	7
Flap	40	55	5
Time:	04:13	04:28	04:43

Wing and Plate Condition After the Takeoff Run
Time: ______
TRAILING EDGE
Flap
8 7 6 5 4 3 2 1
LEADING EDGE
Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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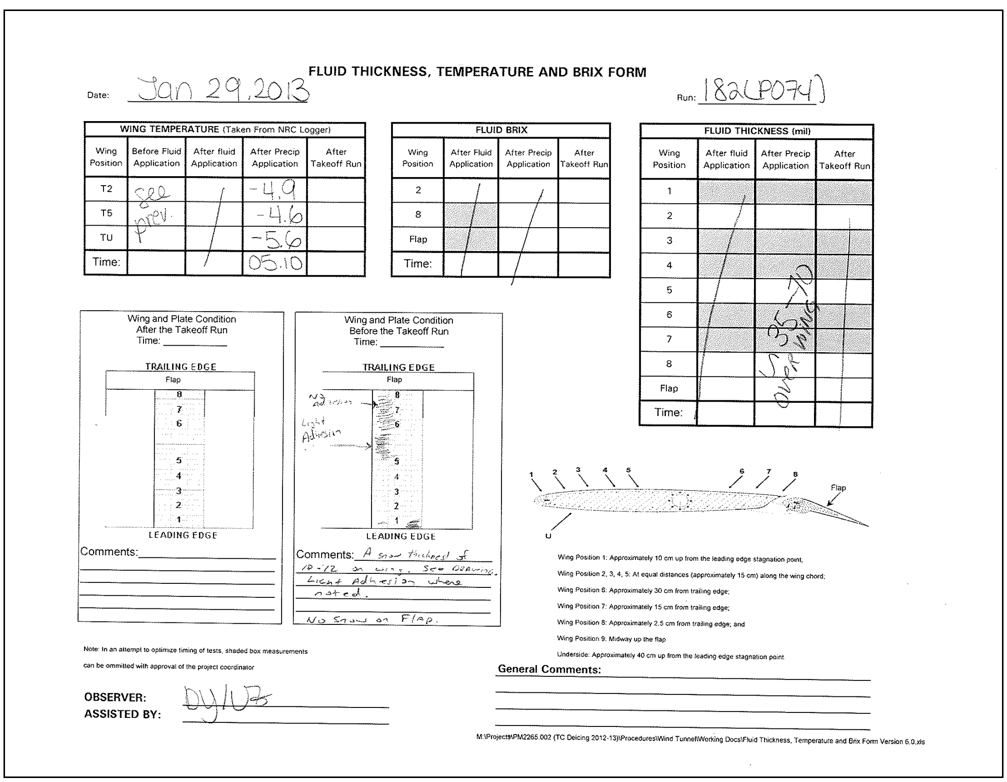
Figure C99: Test #181



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 29, 2013

Run: 182 (P074)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see prev.	/	-4.9	
T5			-4.6	
TU			-5.6	
Time:			05:10	

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		35-70	
6		over wing	
7			
8			
Flap			
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 and Plate Condition Before the Takeoff Run
Time: ______
TRAILING EDGE
Flap
No adhesion → 8 7 6
Light Adhesion → 5 4 3 2 1
LEADING EDGE
Comments: A snow thickness of 10-12 on wing. See drawing. Light adhesion where noted.
No Snow on Flap.

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: DY/VB
ASSISTED BY:

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Figure C100: Test #183

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

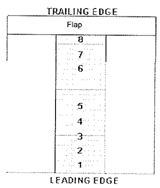
Date: Jan 31.2013 Run: 187 (P054)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-0.9	-1.6	/	-2.6
T5	-1.3	-1.7	/	-2.9
TU	-3.1	-3.1	/	-3.7
Time:	13:30	13:40	/	13:58

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.00	/	37.00
8		/	34.25
Flap		/	35.25
Time:	13:39	/	13:56

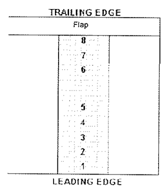
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	134	/	6
3		/	
4		/	
5	158	/	6
6		/	
7		/	
8	119	/	2
Flap	35	/	6
Time:	13:38	/	13:55

Wing and Plate Condition After the Takeoff Run
Time: ____

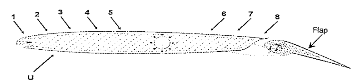


Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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Figure C101: Test #187

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

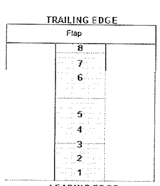
Date: Jan 31, 2013 Run: 188 (P041)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-2.8	-8.9	-6.7
T5		-2.9	-8.6	-6.9
TU		-3.8	-5.0	-6.0
Time:		14:05	14:31	14:38

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	21.00	28.50
8		23.75	28.00
Flap		22.00	29.00
Time:	14:15	14:31	14:46

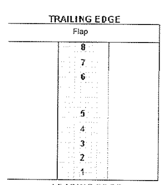
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	158	5
3			
4			
5	127	158	9
6			
7			
8	127	158	8
Flap	50	55	4
Time:	14:14	14:30	14:44

Wing and Plate Condition After the Takeoff Run
Time: ____

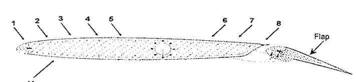


Comments:

Wing and Plate Condition Before 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: DY
ASSISTED BY: VB

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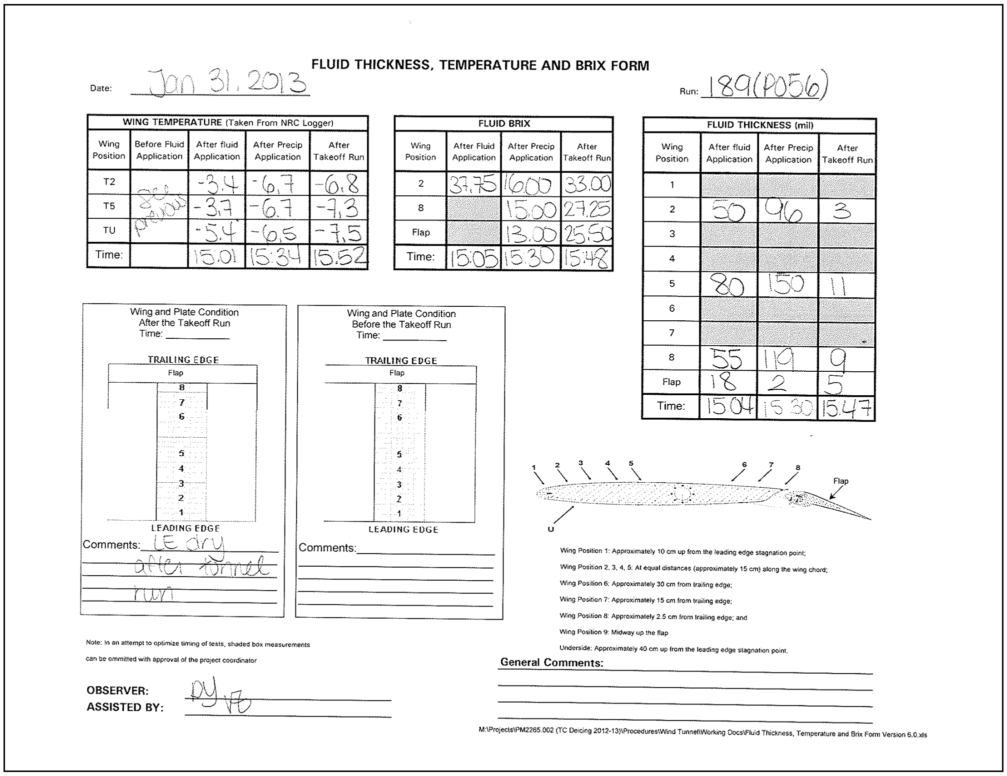
Figure C102: Test #188



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 31, 2013 Run: 189(P056)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-3.4	-6.7	-6.8
T5		-3.7	-6.7	-7.3
TU		-5.4	-6.5	-7.5
Time:		15:01	15:34	15:52

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.75	16.00	33.00
8		15.00	27.25
Flap		13.00	25.50
Time:	15:05	15:30	15:48

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	50	96	3
3			
4			
5	80	150	11
6			
7			
8	55	119	9
Flap	18	2	5
Time:	15:04	15:30	15:47

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: LE dry after tunnel run

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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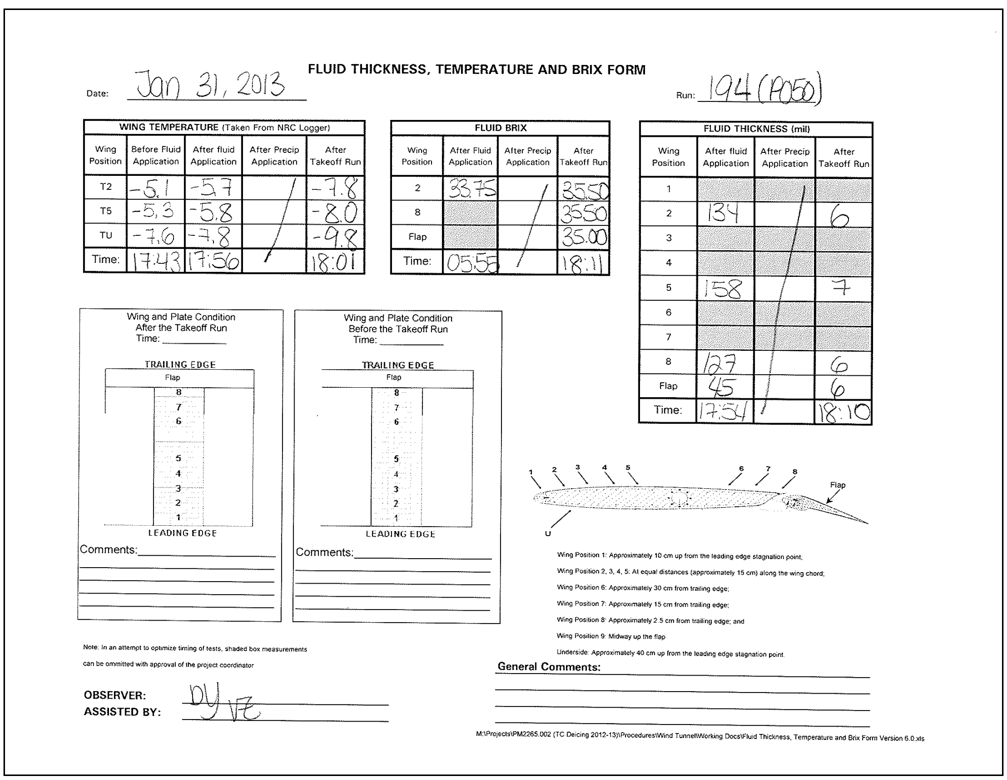
Figure C103: Test #189



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 31, 2013 Run: 194(P050)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	-5.1	-5.7	/	-7.8
T5	-5.3	-5.8		-8.0
TU	-7.6	-7.8		-9.8
Time:	17:43	17:56		18:01

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	33.75	/	35.50
8			35.50
Flap			35.00
Time:	05:55		18:11

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	134		6
3			
4			
5	158		7
6			
7			
8	127		6
Flap	45		6
Time:	17:54		18:10

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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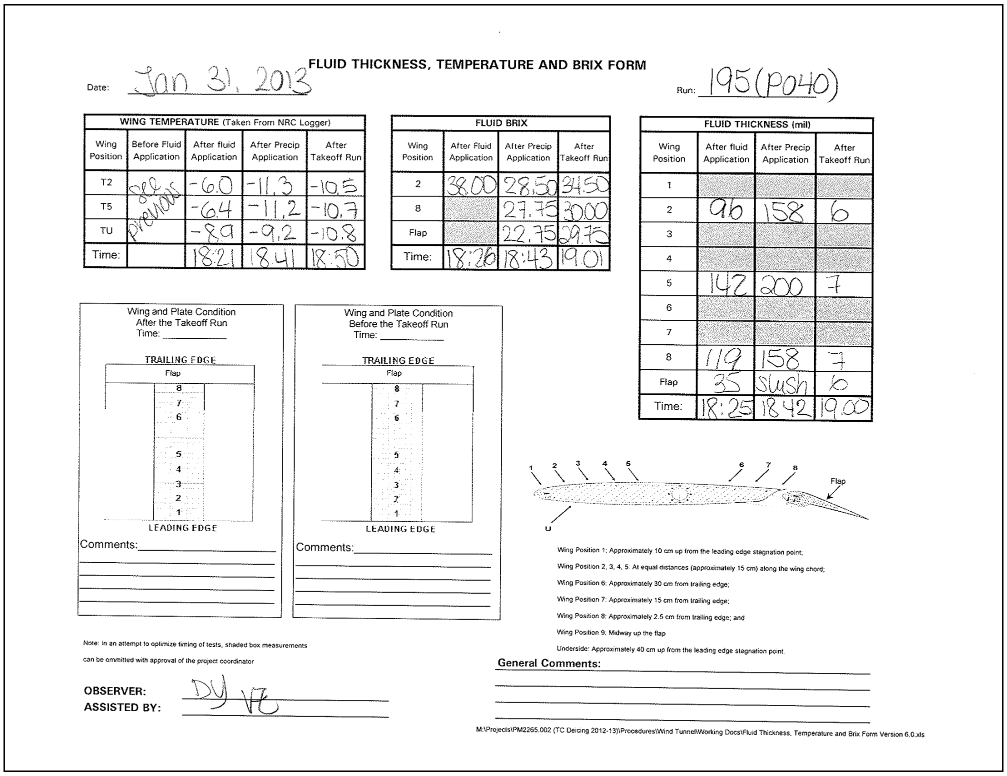
Figure C104: Test #194



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 31, 2013

Run: 195(P040)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-6.0	-11.3	-10.5
T5		-6.4	-11.2	-10.7
TU		-8.9	-9.2	-10.8
Time:		18:21	18:41	18:50

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	38.00	28.50	34.50
8		27.75	30.00
Flap		22.75	29.75
Time:	18:26	18:43	19:01

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	158	6
3			
4			
5	142	200	7
6			
7			
8	119	158	7
Flap	35	slush	6
Time:	18:25	18:42	19:00

Wing and Plate Condition After the Takeoff Run Time: ______

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

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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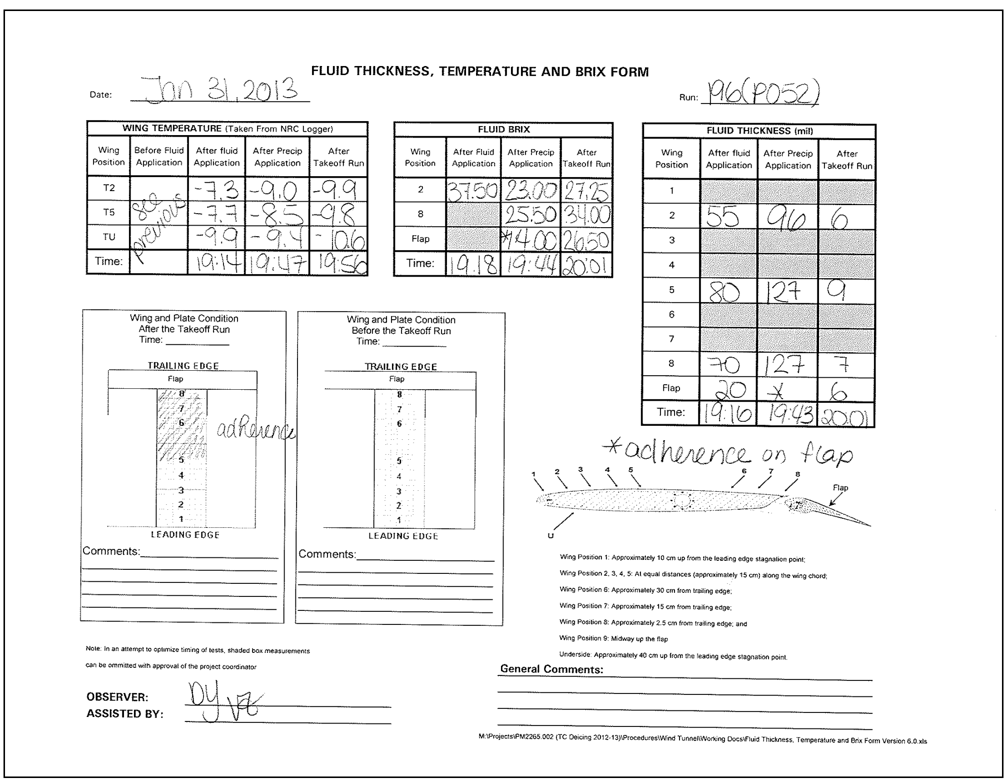
Figure C105: Test #195



FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Jan 31, 2013

Run: 196(P052)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-7.3	-9.0	-9.9
T5		-7.7	-8.5	-9.8
TU		-9.9	-9.4	-10.6
Time:		19:14	19:47	19:56

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.50	23.00	27.25
8		25.50	34.00
Flap		*14.00	26.50
Time:	19:18	19:44	20:01

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	55	96	6
3			
4			
5	80	127	9
6			
7			
8	70	127	7
Flap	20	X	6
Time:	19:16	19:43	20:01

*adherence on flap

Wing and Plate Condition After the Takeoff Run Time: ______

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

adherence

Comments: ______

Wing and Plate Condition Before 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: DY
ASSISTED BY: VF

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Figure C106: Test #196

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Feb 1, 2013

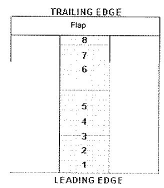
Run: 200(P062)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	n/a	-9.9	/	-11.9
T5	n/a	-10.3	/	-12.3
TU	n/a	-11.2	/	-14.1
Time:	n/a	10:08	/	

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	34.00	/	35.00
8		/	34.00
Flap		/	35.25
Time:	10:09	/	14:23

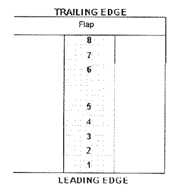
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1		/	
2	112	/	4
3		/	
4		/	
5	158	/	6
6		/	
7		/	
8	104	/	6
Flap	35	/	6
Time:	10:08	/	10:23

Wing and Plate Condition
After the Takeoff Run
Time: ____________

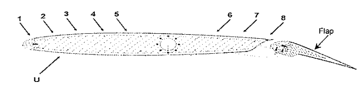


Comments: ____________

Wing and Plate Condition
Before 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: DY
ASSISTED BY: JVE

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Figure C107: Test #200

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Feb 1, 2013

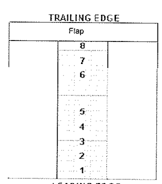
Run: 201(P043)

WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	see previous	-9.9	-12.6	-11.8
T5		-10.4	-12.8	-12.0
TU		-12.4	-12.0	-13.1
Time:		10:52	11:03	11:17

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	30.00	31.00
8		27.00	31.25
Flap		26.75	31.00
Time:	10:51	11:02	11:18

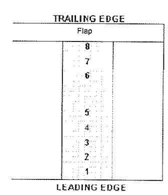
FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	96	112	12
3			
4			
5	119	158	11
6			
7			
8	119	112	12
Flap	30	slush	7
Time:	10:50	11:02	11:17

Wing and Plate Condition
After the Takeoff Run
Time: ____________

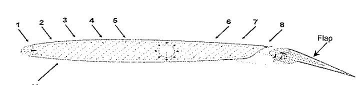


Comments: ____________

Wing and Plate Condition
Before 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: DY
ASSISTED BY: JVE

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Figure C108: Test #201

FLUID THICKNESS, TEMPERATURE AND BRIX FORM

Date: Feb 1, 2013

Run: 202(P068)

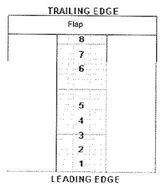
WING TEMPERATURE (Taken From NRC Logger)				
Wing Position	Before Fluid Application	After fluid Application	After Precip Application	After Takeoff Run
T2	See previous	-10.6	-10.2	-12.1
T5		-10.9	-10.1	-12.3
TU		-12.0	-11.9	-13.5
Time:		11:39	11:53	12:04

FLUID BRIX			
Wing Position	After Fluid Application	After Precip Application	After Takeoff Run
2	37.00	25.25	34.25
8		25.25	33.50
Flap		26.00	33.00
Time:	11:41	11:55	12:10

FLUID THICKNESS (mil)			
Wing Position	After fluid Application	After Precip Application	After Takeoff Run
1			
2	65	96	5
3			
4			
5	80	119	11
6			
7			
8	80	96	10
Flap	20	16	7
Time:	11:41	11:55	12:09

Wing and Plate Condition After the Takeoff Run

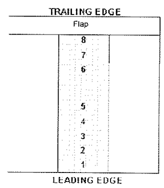
Time: ___________



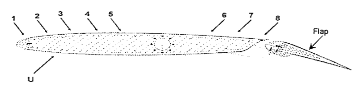
Comments: ___________

Wing and Plate Condition Before 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: DY

ASSISTED BY: JVZ

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Figure C109: Test #202

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