Transport Canada Transports Canada

Advisory Circular

Subject: **Degree-Specific Holdover Times**

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1.0 Introduction

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

(2) Operators are expected to follow the means of compliance described in this AC in all respects, unless the Minister approves an acceptable alternate means of compliance.

(3) The conditions on the use of the Degree-Specific Holdover Time (DSHOT) database appear in Appendix A of this AC.

(4) This AC uses mandatory terms such as “shall”, “requirements” and “is/are required” in order to convey the intent of this and other referenced guidance documents. The term “should” is to be understood to mean that the proposed method of compliance must be used, unless an alternate means of compliance has been determined and approved.

(5) The term “operator” in this AC includes operators flying aircraft operated under the *Canadian Aviation Regulations* (CARs) Part VI and Part VII.

1.1 Purpose

(1) The purpose of this document is to:

(a) provide guidance for the operational approval of the implementation of DSHOT snow data into an operator’s ground icing program (GIP);

(b) specify that all DSHOT data to be used in operations are to be subjected to a defined evaluation process;

(c) provide guidance to assist operators, service providers, contractors, and Transport Canada Civil Aviation (TCCA) personnel in evaluating proposed implementation of DSHOT data; and

(d) provide guidance material and recommendations for Principal Operations Inspectors (POIs) or Civil Aviation Safety Inspectors (CASIs) when evaluating the use of DSHOTs in an operator’s GIP.

1.2 Applicability

(1) This document applies to:

(a) Canadian air operators holding an air operator certificate (AOC) under Subpart 705 of the (CARs); or

(b) All other operators not operating under Subpart 705 of the CARs but that have established an aircraft inspection program in accordance to Standard 622 of the *General Operating and Flight Rules Standards* (GOFRS) — Ground Icing Operations.

(2) This document is also applicable to all TCCA personnel, and to individuals and organizations that exercise privileges granted to them under an External Ministerial Delegation of Authority. This information is also provided to the aviation industry at large for educational purposes.

1.3 Description of changes

(1) Not applicable.

2.0 References and requirements

2.1 Reference documents

(1) It is intended that the following reference materials be used in conjunction with this document:

(a) *Aeronautics Act* (R.S.C., 1985, c. A-2)

(b) Part VI, Subpart 02 of the *Canadian Aviation Regulations* (CARs) — Operating and Flight Rules

(c) Standard 622 of the *General Operating and Flight Rules Standards* (GOFRS) — Ground Icing Operations

(d) Transport Canada Publication —TP 14052 — Guidelines for Aircraft Ground Icing Operations

(e) Transport Canada Publication — Holdover Time Guidelines

(f) Transport Canada Publication — Degree-Specific Holdover Time Database

(g) Transport Canada Publication — Regression Information

(h) Transport Canada Publication — TP 15451 — Regression Coefficients And Equations Used To Develop The Winter 2020-21 Aircraft Ground Deicing Holdover Time Tables

(i) SAE International Aerospace Recommended Practice (ARP) 5485 — Endurance Time Test Procedures for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluids

2.2 Cancelled documents

(1) Not applicable.

(2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

2.3 Definitions and abbreviations

(1) The following **definitions** are used in this document:

(a) **Data Presentation:** Means the method or means by which the data from the DSHOT database is presented in its final and verified form to the end user of the data. This could be a modified paper holdover time (HOT) table, an electronic presentation of a HOT table, or an electronic application (App) in an electronic flight bag (EFB).

(b) **Degree-Specific Holdover Time:** Means the HOT calculated at degree decrements beginning at 3°C down to the aircraft de/anti-icing fluid (ADF)'s lowest operational use temperature (LOUT). The DSHOT database contains an expanded set of snow precipitation HOTs (very light snow, light snow and moderate snow) for all Type II, III and IV ADFs listed in the TCCA HOT Guidelines.

(c) **Generic Holdover Time:** Is the shortest HOT for a given ADF Type (either Type II or Type IV) within a specified temperature range and for a specific precipitation type and intensity. In the absence of knowing what specific ADF is being used to protect the aircraft, the generic holdover times provide the most conservative values and ensure that the lowest ADF HOT is identified to the flight crew.

(d) **Holdover Time**: Is the estimated time that an application of ADF is effective in preventing frost, ice, or snow from adhering to an aircraft's treated surfaces. HOT is calculated as beginning at the start of the final application of ADF and as expiring when the fluid is no longer effective. A HOT may be one which is published by Transport Canada Civil

Aviation (TCCA) in the holdover timetables or one generated by a Holdover Time Determination System (HOTDS).

(e) **Holdover Time Determination System**: Means a near real-time system that samples a number of atmospheric inputs and uses these in conjunction with HOT regression curves and associated coefficients for ADFs to produce a holdover time determination report (HOTDR). A valid HOTDS will meet the Minimum Assurance Requirements Performance Specifications (MARPS) for HOTDS as set out by the Minister.

(f) **Holdover Time Regression Curve**: Means a graphical representation of data inputs (e.g. temperature, precipitation rate) generated in regression analysis. HOT regression curves may employ one or two coefficients which model fluid behaviour. All HOT regression curves are power law-based.

(g) **Power Law**: means a statistical functional relationship between two variables where a change in one variable yields a proportional relative change in the other variable. Compared to a linear relationship between a variable, power law variables vary as a power of another.

(h) **Regression Analysis**: means a set of statistical methods utilized to estimate the relationship between dependent and/or independent variables. In the context of holdover times, it is used to estimate the relationship between the holdover time of an ADF, outdoor ambient temperature (OAT) and precipitation rate.

(2) The following **abbreviations** are used in this document:

(a) **AC:** Advisory Circular

(b) **ADF:** Aircraft De/Anti-icing Fluid

(c) **ARP:** Aerospace Recommended Practice

(d) **CARs:** *Canadian Aviation Regulations*

(e) **COM:** Company Operations Manual

(f) **DSHOT:** Degree-Specific Holdover Time

(g) **DSHOTDA:** Degree-Specific Holdover Time Data Administrator

(h) **EFB:** Electronic Flight Bag

(i) **FAA**: Federal Aviation Administration

(j) **GIP:** Ground Icing Program

(k) **GOFRS:** *General Operating and Flight Rules Standards*

(l) **HOT:** Holdover Time

(m) **HOTDS:** Holdover Time Determination System

(n) **LOUT:** Lowest Operational Use Temperature

(o) **MARPS:** Minimum Assurance Requirements and Performance Specifications

(p) **METAR:** Meteorological Terminal Air Report

(q) **OAT:** Outdoor Ambient Temperature

(r) **POI:** Principle Operations Inspector

(s) **SAE:** Society of Automotive Engineers

(t) **SOP:** Standard Operating Procedures

(u) **SPECI:** Aviation Special Weather Report

(v) **TCCA:** Transport Canada Civil Aviation

3.0 Background

(1) The Holdover Time (HOT) Guidelines are published annually by Transport Canada Civil Aviation (TCCA). The HOT Guidelines contain a series of tables that provide time estimates on the effectiveness of de/anti-icing fluids (ADF) against freezing or frozen precipitation while an aircraft is on the ground. Holdover times can vary depending on the type of ADF used, the type of precipitation (e.g. snow), rate of precipitation (intensity), and outdoor ambient temperature (OAT).

(2) Within a typical HOT table exists ADF HOTs for various freezing and frozen forms of precipitation, these HOTs are provided for defined temperature ranges (e.g. -3 °C to -8 °C). The HOTs provided within a given temperature range are based on the coldest temperature of that range. Operators can typically determine an ADF's HOT by referencing the published HOT table in combination with meteorological information provided at an airport/station (e.g. METAR/SPECI).

(3) Operators may use as an optional service a HOT Determination System (HOTDS) at certain airports/stations. HOTDS comprise of specialized equipment sited at airports that carry out near real-time sampling of atmospheric inputs (e.g. temperature, precipitation rate and type) and use these in combination with HOT regression curves for specific ADF to produce a HOT determination report (HOTDR). The HOTDR contains pertinent information for flight crew including fluid name, type and the calculated holdover time. HOTDS are required to meet the Minimum Assurance Requirements and Performance Specifications (MARPS) for HOTDS as set out by the Minister in *General Operating and Flight Rules Standards* (GOFRS) 622.11 - Ground Icing Operations.

(4) Typically, a HOTDS will provide more precise HOTs compared to the timetable ranges found in the HOT guidelines given that information is real-time and is not bounded within a temperature range. In the absence of using a HOTDS, an operator uses the HOT information in the tabular format as published by TCCA in the HOT guidelines.

(5) To support extending safe air operations in snow conditions and leverage the similar benefits of HOTDS, a significant amount of analytical work to assess the safety and feasibility of publishing a database of Degree-Specific HOTs (DSHOT) was conducted by TCCA in partnership with the Federal Aviation Administration (FAA).

4.0 Degree-Specific Holdover Time (DSHOT) database

(1) The DSHOT database contains an expanded set of snow precipitation HOTs (very light snow, light snow and moderate snow) for all Type II, III and IV anti-icing fluids listed in the HOT Guidelines. For a given fluid, this expanded set contains HOTs calculated at degree decrements (in °C) down to the ADF's lowest operational use temperature (LOUT). The DSHOT database is an extension of the HOT Guidelines.

(2) Given the dynamic nature of meteorological conditions that may shift between METAR reports, the calculations for all holdover times within the DSHOT database factor in 1 degree colder (-1°C) for all temperatures, with the exception of temperatures warmer than 0°C. This ensures a continued level of safety assurance while overall providing expanded holdover times for snow conditions.

(3) DSHOT data is derived from the same natural snow test data used to calculate the snow cells in the published TCCA HOT Guidelines. The methodology for collection of snow data and the calculation of fluid endurance times are found in SAE International Aerospace Recommended Practice (ARP) 5485 — Endurance Time Test Procedures for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluids.

(4) Snow test data is fitted to a power law curve, which best reflects the behaviour of ADF in relation to two main variables – temperature and precipitation intensity. The general form of the regression equation for snow precipitation is $t = 10^{I} R^{A} (2-T)^{B}$, where:

(a) t = time (minutes);

(b) R = rate of precipitation (g/dm²/h);

(c) T = temperature (°C); and

(d) I, A, B = coefficients determined from the regression.

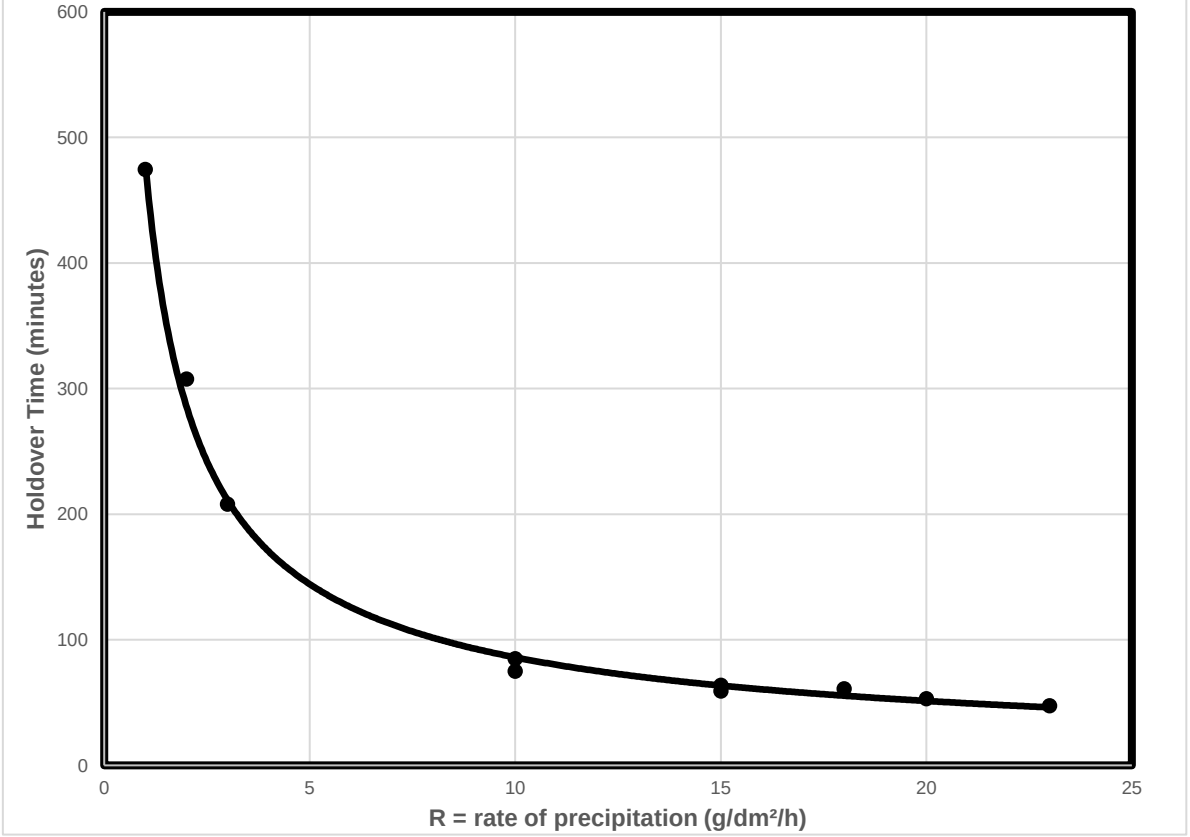
(5) Table 1 provides sample snow data measurements. The resulting power law curve fit yields the following coefficients: I = 3, A = -0.8 and B = -0.3.

Table 1: Sample snow data measurements and resulting holdover times

T = temperature (°C)	R = rate of precipitation (g/dm²/h)	t = Holdover Time (minutes)
-4	20	53
-6	2	308
-8	3	208
-6	10	85
-10	1	475
-10	10	75
-4	23	48
-5	15	64
-3	18	61
-7	15	59

(6) The resulting regression data can be fitted to a curve which provides holdover times for an ADF. Figure 1 provides a visual representation of most ADF regression curves for a given temperature range.

Figure 1: Aircraft De/anti-icing Fluid Regression Curve



(7) Fluid specific DSHOT data is provided for all undiluted Type II, Type III, and Type IV fluids listed within the HOT Guidelines. DSHOT data is also provided in generic format for Type II and Type IV fluids. The generic values for a given fluid type and temperature represent the lowest calculated HOT value of all fluids of that type at the specified temperature.

4.1 Regulatory Framework

(1) In accordance with paragraph 602.11 (4)(b) of the CARs, CARs subpart V of Part VII air operators are required to have an aircraft inspection program in accordance with GOFRS 622.11. Aircraft operated under CARs Part VI or subsections I, II, II, IV of CARs Part VII are required to have an aircraft inspection program if they are unable to immediately inspect their aircraft prior to take-off to determine whether any frost, ice or snow is adhering to an aircraft's critical surfaces.

(2) GOFRS 622.11(3) identifies the aircraft inspection program elements required to be included as part of an operator's ground inspection program (GIP) which includes:

(a) the Operator's Management Plan;

(b) Aircraft Deicing/Anti-icing Procedures;

(c) Holdover Timetables or HOTDR derived from HOTDS;

(d) Aircraft Inspection and Reporting Procedures; and

(e) Training and Testing.

(3) Operators implementing the use of the DSHOT database within their operations must update their aircraft ground icing programs (GIP) in accordance with the guidance of this AC to ensure compliance with GOFRS 622.11(3)(c).

(4) The operator should be able to demonstrate that the use of DSHOT has the equivalent level of workload for flight crew compared to the typical means of using the HOT Guidelines (e.g. paper or an electronic representation of the HOT Guidelines).

5.0 Operator implementation process

(1) Operators incorporating DSHOT into their operations should carefully review the contents of this AC to determine applicable requirements.

(2) From a process perspective it is envisaged that an operator wishing to incorporate DSHOT data will:

(a) decide on the method by which the DSHOT data will be implemented into its GIP;

(b) discuss any implementation concerns with their respective Principal Operations Inspector (POI);

(c) complete all necessary evaluations, document modification, procedures and training modifications as outlined in the appendices of this AC; and

(d) submit changes to Company Operations Manual (COM) and/or GIP to POI for approval.

5.1 Application and structure of this Advisory Circular

(1) This AC provides the conditions and associated guidance applicable to include the DSHOT database as part of an operator's GIP:

(a) Appendix A: Stipulates the conditions for the use of the DSHOT database.

(b) Appendix B: Provides requirements with respect to data management and security of the DHSOT.

(c) Appendix C: Provides guidance with respect to data verification and user validation.

(d) Appendix D: Provides general procedures and training requirements with respect to the DSHOT database.

(e) Appendix E: Features a checklist for the conditions in Appendix A and guidance found in the other Appendices.

6.0 Information management

(1) Not applicable

7.0 Document history

(1) Not applicable

8.0 Contact us

For more information, please contact:

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We invite suggestions for amendment to this document. Submit your comments to:

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Appendix A — Conditions on the use of the DSHOT database

General

(1) Degree-Specific Holdover Time (DSHOT) data is provided in the form of a reference table listing ('xls' format) on the most recent Transport Canada DSHOT data publication. Separate DSHOT values are provided for standard anti-icing operations and for operations where flaps and slats are deployed prior to de/anti-icing. The data will be obtainable from the Transport Canada website: https://tc.canada.ca/en/aviation/general-operating-flight-rules/holdover-time-hot-guidelines-icing-anti-icing-aircraft.

(2) For each aircraft de/anti-icing fluid ADF included, DSHOT data is provided at all temperatures decrementing down to the ADF's lowest operational use temperature (LOUT). A 1°C safeguard is incorporated in all DSHOT calculations (i.e. all published DSHOT values are calculated using a temperature that is 1°C colder than the listed temperature). This mitigates the dynamic nature of meteorological conditions that may shift between METAR reports and potential temperature decreasing.

(3) DSHOTs are provided for precipitation rates of 3, 4, 10, and 25 g/dm²/h. These precipitation rates correspond with the lower and upper precipitation rate boundaries for very light snow (3 to 4 g/dm²/h), light snow (4 to 10 g/dm²/h), and moderate snow (10 to 25 g/dm²/h) used in the HOT Guidelines. Certain Type II fluid-specific HOT tables do not include information for very light snow or light snow. Correspondingly, no DSHOT values have been provided at these intensities for these fluids.

(4) Fluid-specific DSHOTs have only been determined for snow conditions where the standard HOTs are derived through regression analysis. There are some exceptions where DSHOTs cannot be calculated, these are:

- (a) Snow HOTs below -14°C for fluids with generic snow HOTs below -14°C; and
- (b) Snow HOTs below -25°C for fluids with:
  - (i) Fluid-specific snow HOTs below -14°C, and
  - (ii) Fluid LOUT colder than -29.0°C.

(5) In the above-mentioned instances, the related data in the DSHOT database has been populated with the applicable standard (i.e. non-temperature specific) HOTs.

Conditions

(1) The DSHOT database reference tables cannot be used in its published form on its own; the data must be incorporated into an operator's approved GIP and meet the requirements set out in the Appendices of this AC. There are several possible methods by which an operator can utilize the published DSHOT data, including:

- (a) Internal publication of a modified paper HOT table;
- (b) Electronic presentation of a HOT table;
- (c) Incorporation of the DSHOT data into a verified digital display (e.g. Electronic Flight Bag App).

(2) The database must be sourced (e.g. downloaded) from the most recent TCCA DSHOT database publication.

(3) The operator must ensure that the DSHOT database is the most current and their applicable means to present the data such as modified paper tables, an electronic presentation of a HOT table, or an electronic application Electronic Flight Bags (EFB) Application (App) are updated accordingly.

(4) The operator must ensure that all applicable notes and cautions found in the TCCA published HOT guidelines are available when using the DSHOT database and its data presentation. An example of applicable notes and cautions is provided for illustrative purposes below; the operator must still ensure all table-specific notes and cautions appear in the tables that will be part of their GIP.

Table A1: Example of notes and cautions

NOTES

1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type IV fluid cannot be used.
2 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 42) is required.
3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4 Includes light, moderate and heavy freezing drizzle. 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, small hail and hail (Table 41 provides allowance times for ice pellets and small hail).
7 No holdover time guidelines exist for this condition below -10°C (14°F).
8 If the LOUT is unknown, no holdover time guidelines exist below -22.5°C (-9°F).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The only acceptable decision-making criterion, for takeoff without a pre-takeoff contamination inspection, is the shorter time within the applicable 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 below the lowest time stated in the range. 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.

(5) The DSHOT data may be used in full, or in a partial format as required by the operator based on the operator's areas of operation or their operational requirements, such as:

(a) Operators flying exclusively within North America may not need to include Type II data;

(b) Operators who opt not to use fluid-specific holdover time tables may choose not to include them;

(c) Operators who configure their aircraft with deployed flaps or slats may use the adjusted DSHOT.

Appendix B — Data management and security

Operator requirements

1.1 Assignment of DSHOT Data Administrator

(1) The operator shall designate a DSHOT Data Administrator (DSHOTDA) who is suitably qualified, trained and provided with adequate resources to ensure data integrity of the database.

1.2 Data management procedures

(1) The operator shall establish and maintain documented procedures on the acquisition, management and data presentation of the DSHOT database. These procedures must:

(a) clearly document processes for the acquisition, management and distribution of the data;

(b) define access rights for users and administrators;

(c) provide adequate controls to prevent user corruption of data.

1.3 Data security

(1) DSHOT source data must be protected against unauthorized manipulation. The DSHOTDA must add the appropriate level of protection to any DSHOT reference database which is distributed within the operator’s organization.

1.4 Data integrity and verification requirements

(1) Data integrity can be compromised when the original data source (e.g. the DSHOT database) is manipulated to provide the data in a different format. Therefore, the operator shall ensure that end-to-end traceability of data is documented. A detailed verification in accordance with Appendix C shall be completed to ensure migration of the data is accurate and complete at each stage of manipulation.

(2) The verification process shall consist of a series of manual checks of the DSHOT database values within a DSHOT data presentation against the corresponding values published in TCCA DSHOT database. Each DSHOT value for each fluid included within the data presentation shall be verified.

(3) A record of the verification process shall be kept and maintained by the DSHOTDA to ensure that all necessary verification has been performed. The verification record shall clearly demonstrate that all DSHOT values have been verified. Additionally, the verification record shall indicate what date the verification was performed and the person(s), who performed the verification, and which version of the TCCA DSHOT database was used for the check. Blank verification record sheets will be provided within the TCCA DSHOT database. Figure B1 below depicts an example of a completed verification record sheet for one table of DSHOTs (Generic Type IV ADF).

Table B1 – Sample verification table for Generic Type IV ADF DSHOT values

Fluid Name	Ambient Temp (°C)	Snow HOT Rate = 3 g/dm²/h	Verification	Snow HOT Rate = 4 g/dm²/h	Verification	Snow HOT Rate = 10 g/dm²/h	Verification	Snow HOT Rate = 25 g/dm²/h	Verification
Generic Type IV	3	120	✓	120	✓	77	✓	33	✓
Generic Type IV	2	120	✓	120	✓	77	✓	33	✓
Generic Type IV	1	120	✓	120	✓	77	✓	33	✓
Generic Type IV	0	120	✓	120	✓	77	✓	33	✓
Generic Type IV	-1	120	✓	120	✓	76	✓	33	✓
Generic Type IV	-2	120	✓	120	✓	71	✓	33	✓
Generic Type IV	-3	120	✓	120	✓	67	✓	33	✓
Generic Type IV	-4	120	✓	120	✓	63	✓	32	✓
Generic Type IV	-5	120	✓	120	✓	61	✓	31	✓
Generic Type IV	-6	120	✓	116	✓	58	✓	29	✓
Generic Type IV	-7	120	✓	112	✓	56	✓	28	✓
Generic Type IV	-8	120	✓	108	✓	54	✓	27	✓
Generic Type IV	-9	120	✓	103	✓	53	✓	27	✓
Generic Type IV	-10	118	✓	97	✓	51	✓	26	✓
Generic Type IV	-11	111	✓	91	✓	48	✓	25	✓
Generic Type IV	-12	105	✓	86	✓	45	✓	24	✓
Generic Type IV	-13	100	✓	82	✓	43	✓	23	✓
Generic Type IV	-14	95	✓	78	✓	41	✓	22	✓
Generic Type IV	-15	45	✓	30	✓	9	✓	2	✓
Generic Type IV	-16	45	✓	30	✓	9	✓	2	✓
Generic Type IV	-17	45	✓	30	✓	9	✓	2	✓
Generic Type IV	-18	45	✓	30	✓	9	✓	2	✓
Generic Type IV	-19	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-20	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-21	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-22	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-23	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-24	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-25	20	✓	10	✓	3	✓	1	✓
Generic Type IV	-26	10	✓	7	✓	2	✓	0	✓
Generic Type IV	-27	10	✓	7	✓	2	✓	0	✓
Generic Type IV	-28	10	✓	7	✓	2	✓	0	✓
Generic Type IV	-29	10	✓	7	✓	2	✓	0	✓
Generic Type IV	-30	10	✓	7	✓	2	✓	0	✓
Database Version:	**V1.0**	**Date of Verification:**		**2020-06-10**		**Verification Performed by:**		**TC**	

(4) The operator shall ensure that the verification process is updated and/or repeated on an annual basis or whenever the DSHOT database or its data presentation is updated, whichever comes first.

1.5 Quality assurance of DSHOT data management

(1) The operator shall have a quality assurance process in place which contains at a minimum:

(a) DSHOT data management related checklists;

(b) DSHOT data management process standards;

(c) DSHOT data management process documentation; and

(d) DSHOT data management oversight/audit.

(2) The operator shall have a process in place which assures that in the event of DSHOT data failure, there is a viable alternative to provide guidance to flight crew to establish holdover times, especially where a failure would lead to the presentation of potentially incorrect or misleading information.

1.6 Degree-Specific Holdover Times data presentation

(1) Readability

(a) Text size and font type for the DSHOT data presentation should ensure readability at the intended viewing distance, and the information layout should ensure clarity and prevent any ambiguity.

(2) Interface and data format

(a) Good data presentation is an important safety factor when DSHOT data is being used. The following are essential design guidelines to be considered when developing a DSHOT data presentation:

(i) Fluid names used in any data presentation shall match those used in the HOT Guidelines;

(ii) Notes and cautions provided in any data presentation shall be worded the same as in the HOT Guidelines;

(iii) The data presentation should minimize the risk of misinterpretation of the DSHOT values; and

(iv) The DSHOT data should be presented in a format that is consistent with the training that end users receive. The interface design, including, but not limited to, color-coding philosophies, and symbols, should be consistent with other representations of HOT within the operator’s GIP.

Appendix C — Data verification and operator validation

Data verification

(1) General

(a) Operators shall ensure that the degree-specific holdover time (DSHOT) data presentation intended to be provided to flight crew in either physical media (e.g. paper) or via a digital display (e.g. EFB) is verified.

(b) The operator may appoint a third party to carry out the verification process.

(2) Information and data fields to be verified

(a) At a minimum, the operator shall ensure the following information is verified for each individual aircraft de/anti-icing fluid (ADF) that will be used from the DSHOT database as part of its ground icing program (GIP).

(i) ADF name

(ii) Temperature at each degree (°C) decrement beginning at 3°C down to the ADF's lowest operational use temperature (LOUT). For each degree (°C) :

(A) The ADF's HOT for snow at precipitation rate of 3 g/dm²/h (very light snow)

(B) The ADF's HOT for snow at precipitation rate of 4 g/dm²/h (upper threshold of very light snow and lower threshold of light snow)

(C) The ADF's HOT for snow at precipitation rate of 10 g/dm²/h (upper threshold of light snow and lower threshold of moderate snow)

(D) The ADF's HOT for snow at precipitation rate of 25 g/dm²/h (upper threshold of moderate snow)

Operator validation

(1) As part of its GIP, the operator shall confirm that it has validated the DSHOT data verification process to ensure that the DSHOT data presentation intended to be provided to flight crew in either physical media or via a digital display is verified.

Appendix D — Procedures and training requirements

Degree-Specific Holdover Times – crew training and procedures

(1) Workload

(a) The DSHOT data presentation should be designed to minimize flight crew workload. An evaluation of the DSHOT data presentation should include a qualitative assessment of incremental pilot workload, as well as pilot-system interfaces and their safety implications. The use of DSHOT data should not result in any increase to pilot workload when compared to the use of standard HOT guidance.

(2) Crew procedures

(a) Clear limitations on the use of DSHOT data and crew procedures should be provided and documented.

(b) The procedures shall:

(i) be properly integrated with existing Standard Operating Procedures (SOPs);

(ii) contain suitable crew crosschecks for verifying safety critical data; and

(iii) mitigate and/or control any additional workload associated with the use of DSHOT data.

(3) Training program

(a) The operator shall establish suitable training programs on the use of DSHOT for ground staff, crew members and service providers. Once it is established, the training program must be evaluated to determine that:

(i) the training program is fully documented;

(ii) the training methodology matches the level of knowledge and experience of the participants;

(iii) the operator has assigned adequate resources to deliver the training;

(iv) adequate DSHOT data presentations have been provided;

(v) human factors and cockpit resource management are included in the training; and

(vi) the training material matches both the presentation of the DSHOT data in its final form and the published procedures.

Appendix E — DSHOT database checklist

Item	Checklist item	Acceptable Yes/No/NA	Review date	Remarks
1	**Degree-Specific Holdover Time Data Administrator (DSHOTDA)**			
	Is the appointed DSHOTDA suitably qualified and trained?			
	Are there adequate resources assigned to enable the DSHOTDA to carry out functions?			
2	**Data management procedures**			
	Are there documented processes for the acquisition, management and distribution of the data?			
	Are the access rights for users and administrators to manage data clearly defined?			
	Are there adequate controls to prevent user corruption of data?			
3	**Data security**			
	Have appropriate safeguards been applied to all DSHOT reference files?			
4	**Data integrity and verification**			
	Has the operator ensured that end-to-end traceability of data is documented?			
	Have procedures been documented to log all data management activities for audit and traceability purposes?			
	Has verification of the DSHOT values been performed for all HOT values included within the DSHOT data presentation?			
	Is there a record of the verification process?			
	Is the sourced DSHOT database the most recent and has the verification process of its presentation been updated?			

Item	Checklist item	Acceptable Yes/No/NA	Review date	Remarks
5	**Readability**			
	Do the text size and font ensure readability at the intended viewing distance?			
	Is the DSHOT information layout clear and unambiguous?			
6	**Interface and data format**			
	Are the fluid names in the data presentation consistent with the fluid names in the HOT Guidelines?			
	Are the notes and cautions included in the data presentation worded the same as in the HOT Guidelines?			
	Is the data presentation consistent with the training that end users have received?			
	Is the data presentation consistent with other representations of HOTs within the operator's ground icing program?			
7	**Workload**			
	Has the effect overall impact of including DSHOT data in the data presentation on pilot workload been evaluated?			
8	**Crew procedures**			
	Are there appropriate procedures for crew usage of DSHOT data?			
	Are the procedures clearly presented, suitably illustrated and readily understood?			
	Have crew procedures for the use of DSHOT data been integrated with existing SOPs?			
	Is any additional workload mitigated and/ or controlled?			
9	**Training program**			
	Are flight crew members, and (where applicable) ground staff and service provider training programs fully documented?			

Item	Checklist item	Acceptable Yes/No/NA	Review date	Remarks
	Is the training methodology matched appropriately to the participant's level of experience and knowledge?			
	Has the operator assigned adequate resources (time/personnel/facilities) for training?			
	Does the training material match both the presentation of the DSHOT data in its final form and the published procedures?			
	Does the training program include human factors in relation to DSHOT use?			
	Is there a published recurrent training?			
	Comments			