Aircraft Deicing / Anti-Icing Program

(990114)

Revision Number: 23
Revision Date: 2023-09-28

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REVISION TRACKING RECORD

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REVISION TRACKING RECORD

Document Control Information

Document Title:	Admin Aircraft Deicing/Anti-Icing Program	**Revision:**	23
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* = Added Cancelled = Remove and Discard

Approved: V. Gonzales Filed By: U247981 Date: 09/29/2023 Page: 1 of 1

RECORD OF REVISIONS

MANUAL CODE:	990114	TITLE:	Aircraft Deicing / Anti-Icing Program Manual

REVISION NUMBER	REVISION DATE	PUBLISHED BY
23	09/28/2023	U247981
22	06/23/2022	U247981
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18	06/01/2020	CM U232068
17	01/06/2020	CM U232068
16	10/25/2019	CM U232068
15	06/17/2019	CM U232068
14	02/11/2019	MRC U258284
13	06/15/2018	CMU232068
12	11/10/2017	CMU232068
11	07/20/2017	CMU232068
10	12/12/2016	CMU232068
09	12/11/2015	CMF8850
08	08/14/2015	CMF8850
07	12/22/2014	CMF8850
06	12/01/2014	CMF8850
05	06/13/2014	JPD8412
04	03/28/2014	CMF8850
03	10/15/2013	CMF8850

02	08/31/2012	CMF8850
01	10/01/2011	CMF8850
Original	09/01/2011	CMF8850

REVISION TRANSMITTAL

Manual:	AIRCRAFT DEICING / ANIT-ICING PROGRAM	Manual Code:	990114
Revision:	23	Revision Date:	09/28/2023

- Each manual holder issued an air carrier manual shall have the manual or appropriate parts of it accessible when performing assigned duties 14 CFR Part 121.137.

SECTION	REMARKS
05-01-02 - INTENTIONALLY LEFT BLANK	Deleted Subject.
05-01-03 - INTENTIONALLY LEFT BLANK	Deleted Subject.
05-01-04 - INTENTIONALLY LEFT BLANK	Deleted Subject.
05-10-10 - INTENTIONALLY LEFT BLANK	Deleted Subject.
05-01-12 - INTENTIONALLY LEFT BLANK	Deleted Subject.
11-00-01 - FOREWORD	Deleted Subject.
11-01-01 - DE / ANTI-ICING FLUIDS	Deleted Subject.
11-01-02 - DE / ANTI-ICING OPERATIONS	Deleted Subject.
11-01-03 - OFF GATE DE / ANTI-ICING OPERATIONS	Deleted Subject.
11-01-04 - AIRCRAFT TYPES	Deleted Subject.
11-01-05 - DE / ANTI-ICING EQUIPMENT	Deleted Subject.
11-01-06 - DE / ANTI-ICING COORDINATION	Deleted Subject.
11-01-07 - ANNEX A - NO SPRAY AREAS	Deleted Subject.
11-02-08 - TRAINING	Deleted Subject.
11-02-09 - ANNEX B - TEACHING PLAN	Deleted Subject.
11-03-10 - QUALITY CONTROL	Deleted Subject.
11-03-11 - DE / ANTI-ICING INTERNATIONAL VENDOR AUDIT CHECKLIST	Deleted Subject.

SECTION	REMARKS
11-03-12 - DEVA CHECKLIST ADMINISTRATION	Deleted Subject.
11-04-13 - AERODYNAMICS	Deleted Subject.
11-04-14 - WEATHER	Deleted Subject.
11-04-15 - HEALTH AND SAFETY	Deleted Subject.
11-04-16 - DE / ANTI-ICING FLUIDS	Deleted Subject.
11-04-17 - ANNEX C - ABBREVIATIONS	Deleted Subject.
11-04-18 - ANNEX D - BIBLIOGRAPHY	Deleted Subject.
01-01-01 DOCUMENT CONTROL	TDCR_5173 and TDCR_5224 Link
	7.A.(1) Revised to 'contains manual references to specific manuals' Link
	8. Inserted new section Referenced Procedures from 10-01-01 Link
02-01-01 AUTHORITIES & RESPONSIBILITIES	TDCR_5173 Link
	10.E. Inserted 'The core of this program is the De / Anti-Icing Vendor Audit (DEVA) which audits the service providers program to SAE Aerospace Standards AS6285 Aircraft Ground Deicing / Anti-Icing Processes (current version) and AS6286 Aircraft Ground Deicing / Anti-Icing Training and Qualification Program (current version).' Link
	12. Revised graphic Link
	13. Revised graphic Link
03-01-01 TRAINING	TDCR_5173 Link
	4.A.(3) Revised to 'Senior Manager Flight Dispatch Training' Link
	4.A.(3)(a) Revised Dispatch Training content list Link
	5.A. Revised to '2023' Link
	9.A.(1) Revised to '2023' Link
	9.A.(2) Revised to '2023' Link
	9.A.(3) Revised to '2023' Link
	9.A.(4) Revised to '2023' Link
	9.A.(5) Revised to '2023' Link
	9.A.(6) Revised to '2023' Link

SECTION	REMARKS
	9.A.(7) Revised to '2023' Link
	9.A.(8) Revised to '2023' Link
	9.A.(9) Revised to '2023' Link
	9.A.(10) Revised to '2023' Link
	9.A.(11) Revised to '2023' Link
	9.B.(2) Revised to '2023' Link
	9.B.(2)(a)9 Revised list to '2023' Link
	9.B.(3) Revised to '2023' Link
	9.B.(3)(b)5 Revised list to '2023' Link
	9.B.(4) Revised to '2023' Link
	9.B.(4)(b)5 Revised list to '2023' Link
	9.B.(5) Revised to '2023' Link
	9.C.(1) Revised to '2023' Link
	9.C.(1)(a)6a Revised to '2023' Link
	9.C.(2) Revised to '2023' Link
	9.D.(1) Revised to '2023' Link
	9.D.(1)(a)6 Revised to '2023' Link
	9.D.(1)(a)6 Revised list to '2023' Link
	9.D.(2) Revised to '2023' Link
	9.D.(3) Revised to '2023' Link
	9.D.(3)(a)6 Revised to '2023' Link
	9.D.(3)(a)6 Revised list to '2023' Link
	9.D.(4) Revised to '2023' Link
05-01-01 GENERAL	TDCR_5173 and TDCR_5224 Link
	Replaced content with 'Reference Flight Operations Manual (FOM) Chapter 7 Section 30 “Deicing/Anti-Icing”' Link
05-01-05 SNOWFLAKE	TDCR_5173 and TDCR_5224 Link
	Revised to ATA format Link
05-01-06 COLD WEATHER OPERATION - 737	TDCR_5173 and TDCR_5224 Link

SECTION	REMARKS
	Replaced content with 'Reference 737 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”' Link
05-01-07 COLD WEATHER OPERATION - 757/767	TDCR_5173 and TDCR_5224 Link
	Replaced content with 'Reference 757-767 Flight Manual Chapter 4 Section 10 “Cold Weather Operations”' Link
05-01-08 COLD WEATHER OPERATION - 777	TDCR_5173 and TDCR_5224 Link
	Replaced content with 'Reference 777 Flight Manual Chapter 4 Section 10 “Cold Weather Operations”' Link
05-01-09 COLD WEATHER OPERATION - A319 / 320	TDCR_5173 and TDCR_5224 Link
	Replaced content with 'Reference 319-320 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”' Link
05-01-11 COLD WEATHER OPERATION - 787	TDCR_5173 and TDCR_5224 Link
	Replaced content with 'Reference 787 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”' Link
06-01-01 PRODUCTS & ENGINEERING	TDCR_5173 and TDCR_5224 Link
	4.A.(3)(a) Revised to 'typically orange' Link
	5.A. Type I Deicing Fluids Table Inserted new 14 fluid row; Renumbered remaining table Link
	10.C. Type IV Anti-Icing Fluids Table Revised 43 fluid row; Inserted new 45 fluid row; Renumbered remaining table Link
	12.A. Inserted new Figure 14. Safewing MP | LDF 80; Renumbered remaining Figures Link
	12.B. Deleted Figure 34. Ecowing 26 Link
	12.C. Revised Figure 43. to ChemR Nordik IV; Inserted new Figure 45. Safewing MP IV Launch Plus; Renumbered remaining Figures Link
07-01-01 HOLDOVER TIME	TDCR_5173 Link
	Replaced content to 'Please visit the web address to the FAA Aircraft Ground Deicing page which contains the most current version of the Holdover Time Tables. This list is all fluids accepted by the FAA. United Engineering must approve all fluid in use. For a list of fluids approved for use by United Engineering please reference 06-01-01 of this manual.' Link
08-01-01 EQUIPMENT, FLUID STORAGE FACILITIES & SAFETY	TDCR_5173 Link
	4.B.(2) Inserted preseason preventive maintenance checks per GSE program requirements section Link
09-01-01 DOCUMENTATION	TDCR_5173 Link

SECTION	REMARKS
	4.E.(1)(e) Inserted 'Driver name and employee number' Link
	4.E.(1)(f) Inserted 'Sprayer name and employee number' Link
	4.E.(1)(m) Inserted 'Type I Gallons used' Link
	4.E.(1)(n) Inserted 'Type II, III, IV (as applicable) gallons used if applied'; Deleted 'Employee Number of the person who completed the post deicing / anti-icing check' Link
	4.H.(1) Revised to 'Daily User Check List form' Link
	4.H.(3) Revised to 'Daily User Check List form' Link
	4.I.(2)(o)9 Inserted 'If any above questions result in a failed response, local mitigation must be provided as part of the observation submission.' Link
10-01-01 GLOSSARY	TDCR_5173 and TDCR_5224 Link
	Revised to new Glossary format Link
11-00 EXECUTIVE SUMMARY	TDCR_5173 and TDCR_5224 Link
	Deleted FOREWORD from title Link
11-00-00 EXECUTIVE SUMMARY	TDCR_5173 and TDCR_5224 Link
	Revised Executive Summary graphic Link

FAA APPROVAL LETTER

FAA APPROVAL LETTER

U.S. Department
of Transportation
Federal Aviation Administration

Air Carrier Safety Assurance Group
United Certificate Management Office

2300 E. Devon Avenue, Suite 350
Des Plaines, Illinois 60018
Phone 847-294-8500
FAX: 847-294-8504

September 29, 2023

Mr. David Kinzleman
Senior Vice President - Airport Operations
United Airlines, Inc.
233 South Wacker Drive
Chicago, Illinois 60606

Dear Mr. Kinzleman:

The United Airlines (UA) Aircraft Deicing/Anti-icing Program Manual (ADAP), Revision 23, dated 09-28-2023, is approved. The approved revision pages are enclosed.

If we may be of further assistance in this matter, please do not hesitate to contact Inspector Scott Wood at (303) 342-1973 or me at (847) 294-8507.

Sincerely,

JOSEPH S HANLEY

Digitally signed by JOSEPH S HANLEY
Date: 2023.09.29 08:36:33 -04'00'

Joseph S. Hanley
Supervisory Principal Operations Inspector

Enclosures

Cc: Steve Klein

LIST OF EFFECTIVE SECTIONS

Changes are marked as follows:

- N: New
- R: Revised
- D: Deleted
- U: Unchanged

All effective sections are displayed in this section.

Subject	Change	Revision #	Revision Date
01-01-01 DOCUMENT CONTROL	R	23	2023-09-28
02-01-01 AUTHORITIES & RESPONSIBILITIES	R	23	2023-09-28
03-01-01 TRAINING	R	23	2023-09-28
04-01-01 GROUND POLICY & PROCEDURES	U	18	2020-07-01
05-01-01 GENERAL	R	23	2023-09-28
05-01-05 SNOWFLAKE	R	23	2023-09-28
05-01-06 COLD WEATHER OPERATION - 737	R	23	2023-09-28
05-01-07 COLD WEATHER OPERATION - 757/767	R	23	2023-09-28
05-01-08 COLD WEATHER OPERATION - 777	R	23	2023-09-28
05-01-09 COLD WEATHER OPERATION - A319 / 320	R	23	2023-09-28
05-01-11 COLD WEATHER OPERATION - 787	R	23	2023-09-28
06-01-01 PRODUCTS & ENGINEERING	R	23	2023-09-28
07-01-01 HOLDOVER TIME	R	23	2023-09-28
08-01-01 EQUIPMENT, FLUID STORAGE FACILITIES & SAFETY	R	23	2023-09-28
09-01-01 DOCUMENTATION	R	23	2023-09-28
10-01-01 GLOSSARY	R	23	2023-09-28
11-00-00 EXECUTIVE SUMMARY	R	23	2023-09-28

DOCUMENT CONTROL

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1. General / Policy Overview

   A. This program complies with Title 14 of the Code of Federal Regulations 14 CFR Part 121.629 and is harmonized with Society of Automotive Engineers, Aerospace Standard (SAE AS6285).

2. Purpose

   A. To provide policy necessary for compliance of applicable Federal Regulations and appropriate interfacing with the Flight Operations Manual as identified in Chapter 5.

   B. The Winter Operations corporate team interacts with other groups including but not limited to Airport Operations, Technical Operations, Flight Operations, Internal Evaluation Program (IEP) and AP Quality Control (AOQC) to ensure safe deicing performance.

3. Scope

   A. Applies to deicing and anti-icing of United Airlines' flights and must be followed by all employees participating in deicing and anti-icing roles.

4. Policies

   A. 14 CFR Part 121.629 states that “No person may dispatch, release or takeoff an aircraft any time conditions are such that frost, ice, or snow may reasonable be expected to adhere to the aircraft, unless the certificate hold has an approved deicing/anti-icing program in its operations specifications and unless the dispatch, release and takeoff comply with that program. No person may dispatch or release an aircraft, continue to operate an aircraft en-route, or land an aircraft when in the opinion of the pilot in command or aircraft dispatcher, that icing conditions are expected and might adversely affect the safety of the flight.”

   B. This manual includes guidance from the FAA approved Winter Update Notice N8900 as annually amended.

   C. Through the Safety Management System’s Safety Assurance Process, Airport Operations use various performance and audit sources including but not limited to IEP and AOQC audits to monitor compliance and to identify potential hazards within the Aircraft Deicing Anti-icing Program. The output of data is reviewed, when applicable, at Safety Action Team (SAT) meeting and is intended to improve the quality of the program, its’ processes, as well as provide a means for ensuring compliance.

5. Document Control

   A. Aircraft Deicing / Anti-icing Program (ADAP) Control - The ADAP Manual is a controlled document, and it is available electronically to all Cold Weather Stations, Service Providers using this program and members of the Corporate Winter Operations Committee (CWOC).

   B. FAA Control - This manual and revisions to this manual will be submitted by United's Senior Vice President Airport Operations to the applicable Certificate Management Field Office (CMFO) representing the FAA Administrator prior to implementation as an Approved Program.

   C. United’s Control - Senior Vice President Airport Operations is responsible for creating and submitting the proposed United ADAP Manual revisions to the FAA Administrator for review and approval. When approved, revisions to the ADAP Manual are published electronically. The ADAP Manual revisions do not take effect until FAA Administrator approves them. The ADAP

Manual is controlled by Airport Operations and is part of the Division Manual Tree located in Chapter 11 of the Airport Operations Business Manual (AOBM).

D. Document Revision

(1) The manual is reviewed annually by the Corporate Winter Operations Committee (CWOC). All data collected throughout the season is evaluated and analyzed to improve the program. If a proposed change is determined to be critical, the proposed revision will be submitted to the Certificate Management Office outside of the annual review process and communicated to the field via bulletin published by corporate communications.

(2) Change requests should be submitted to WinterOps@united.com. All change requests will be sent through CWOC review process, the proper SMS process and submitted for FAA Approval.

(3) A review of the ADAP will also include a comparison to requirements in the United Airlines Documentation System Manual (DSM) including but not limited to Chapter 5 to ensure the manual continues to meet the company standard. Updates that impact changes in policy will be conducted in accordance with requirements.

6. Electronic Access

A. Control of this document is electronic. It is located within the United electronic Manual System. All cold weather stations must demonstrate they have access to the manual system. This requirement is for both mainline stations performing the function with United employees or using a Service Provider for the function. In the event of a partial Local Area Network (LAN) failure or any interface link failure, attempt to use another computer workstation and / or printer. Should access to the ADAP Manual be necessary during such a failure, stations should contact United Network Operations Center (NOC) as applicable for assistance. Follow standard corporate procedures for reporting computer outages.

7. Document Pathway

A. Use the "Search Path" provided to access information for the cold weather information for:

(1) Flight Operations

(a) Within the United Flight Operations structure, operational policies and procedures are defined, implemented and quality controlled. Flight Operations is responsible for reviewing and harmonizing the deicing / anti-icing program with their related documents. Chapter 5 of the ADAP Manual contains manual references to specific manuals.

(2) Contract Strategy - Ground Handling Sales

(a) Any United station providing deicing services must ensure a contract with the carrier (or other organization) has been executed. If no contract exists, an ad hoc sales and service contract should be executed. A sample of this form may be found on the winter operations SharePoint. Contact the United Airlines Senior Manager Aircraft Move Teams and Winter Operations for further instructions or questions.

(b) Winter Operations Management Plan (supplemental information):

Search Path:

https://winterops.ual.com

(3) Winter Operations SharePoint

(a) The SharePoint contains specific information to support cold weather stations during the winter season. Paste the link below into your browser.

Search Path:

http://team.ual.com/collab/winterops/pages/Home.aspx

This material is uncontrolled.

8. Referenced Procedures

A. FAA Documents

(1) FAA, [14 CFR Part 121.629], “Operation in icing conditions”

(2) FAA, Approved Winter Update Notice 8900.xx, “FAA-Approved Deicing Program Updates”

(3) FAA, Advisory Circular 120-60b , "Ground Deicing and Anti-icing Program"

(4) [14 CFR Part 119.43], “Certificate Holders duty to maintain operation specification”

(5) [14 CFR Part 121.135], “Manual Content”

B. Company Documents

(1) FOM, Chapter 7 Adverse Weather (Deicing / Anti-Icing) and individual Jeppesen Airport Information (10-7, 20-7).

(2) Fleet specific Flight Manuals – Airbus 319/320, Boeing 737, 747, 757-767, 777, 787

(3) Ramp Service Manual

(4) Documentation Standards Manual

C. Industry Documents

(1) SAE, AS 6285 Aircraft Deicing / Anti-icing Methods

(2) SAE, AS 6286 Training Program Guidelines for De / Anti-icing of Aircraft

(3) SAE, ARP 1971 Aircraft Deicing Vehicle - Self-Propelled, Large and Small Capacity

(4) SAE, AMS 1424/1/2 Deicing Type I fluid

(5) SAE, AMS 1428/1/2 Anti-icing Type II/III/IV fluid

(6) SAE, AMS 1431 Runway deicer – liquid

(7) SAE, AMS 1435 Runway deicer – solid

AUTHORITIES & RESPONSIBILITIES

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AUTHORITIES & RESPONSIBILITIES

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1. General / Policy Overview

   A. This section describes the different levels of authority as they relate to the Aircraft Deicing / Anti-Icing Program (ADAP) Manual.

2. Purpose

   A. To provide clarification for each level of authority and responsibility as it relates to the ADAP Manual.

3. Scope

   A. This manual describes United's means and methods of compliance with Title 14 of the Code of Federal Regulations 14 CFR Part 121.629 regarding “Operation in icing conditions” specifically ground deicing operations as authorized by Operations Specification A023. The document defines the United Airlines Aircraft Deicing / Anti-Icing Program, hereafter referred to as the “ADAP” including all specific items indicated in Title 14 of the Code of Federal Regulations 14 CFR Part 121.629. The Aircraft Deicing / Anti-icing Program is designed to harmonize its requirements with international standards published in Society of Automotive Engineers (SAE) AS 6285 as revised, “Aircraft Ground Deicing / Anti-Icing Processes”. The Aircraft Deicing / Anti-icing Program complies with the specific aircraft manufacturer recommendations.

4. Program Authorities and Responsibilities

   A. Overall Supervision - The Senior Vice President Airport Operations has responsibility and authority for management and oversight of the ADAP and delegates authority for management to the Corporate Winter Operations Committee (CWOC) and Station Management.

   B. The ADAP is a document that describes United's procedures and has been approved by United and the FAA. This program establishes the minimum criteria for United's operations. Compliance with these criteria are audited and documented internally by United Quality Assurance, Quality Control and externally by the FAA, and associated results are evaluated. Continued surveillance audits are accomplished on an opportunity based on the quality assurance department scheduled station visits. Any other audits must be accomplished using the criteria spelled out in the ADAP.

   C. Overall Implementation –

      (1) The CWOC has authority to revise the present document.

      (2) Approval of the document revision by FAA Certificate Management Office (CMO) is required prior to implementation.

      (3) The Corporate Winter Operations Committee Chair is the Director Airport Operations Performance and Execution or designee. The Corporate Winter Operations Committee Chairman determines changes to the decision process of the ADAP.

      (4) The CWOC is consultative to the Senior Vice President Airport Operations on matters pertinent to the ADAP and consists of representatives from the following departments familiar with regulatory and corporate requirements related to this program:

         (a) Customer Strategy and Innovation

         (b) Airport Operations

(c) Airport Operations Quality Control

(d) Systems Engineering

(e) Training

(f) Safety

(g) Environmental

(h) Flight Operations / Flight Standards / Flight Training

(i) Quality Assurance

(j) Station Operations (Hubs and Line stations)

(k) Procurement

(l) Contract Strategy - Ground Handling Sales

(m) Ground Service Equipment and Facility Maintenance, Operations Support

(n) Network Operations Center

(o) Technical Operations Quality Assurance

(p) Technical Operations

(5) United with its CWOC is responsible to ensure the overall ADAP quality control, technology and regulatory issues are addressed and maintained.

(a) The Core Members of the CWOC have the responsibilities to review, approve and update the Winter Operations station plans and escalate any plan not approved after the assigned ready date.

(b) The Corporate Winter Operations team will review the ready dates submitted in the Winter Ops plans for accuracy prior to the established station winter ready dates.

(c) The Head of Deicing Program and Training is delegated by the Senior Management team to Manager Winter Operations.

(6) Operating aircraft in cold weather presents unique problems due to the effects of inclement weather conditions. A program of preventative servicing can minimize aircraft downtime and delays in flight schedules. Particular attention should be directed toward safeguarding the operational integrity of the aircraft throughout all phases of cold weather servicing. This policy is the responsibility of the CWOC and all personnel involved in aircraft deicing / anti-icing operations.

(7) The CWOC charter, located in Flying Together on the Winter Operations SharePoint, describes the mission / goals, authority / escalation and committee processes to be used when evaluating new technologies, industry standards and the process and measurement used to validate the service provider.

(8) The CWOC is also responsible to ensure all necessary elements of the ADAP have been developed, properly integrated, coordinated and disseminated to all persons who have duties, responsibilities, and / or functions to perform in accordance with them.

5. Cold Weather Stations

   A. Cold Weather Stations are listed in the Winter Operations SharePoint. This display provides a list of the station target readiness dates based on historical data.

   B. Prior to the target readiness date of the station, the following items must be completed:

      (1) Ensure the current ADAP is readily available at the station.

      (2) Meet / Schedule with the local Air Traffic Control Tower (ATCT) and the local airport authorities to determine the best possible winter operation process.

      (3) Adequate winter operations ground service equipment and facility resources are available. Preventative maintenance checks on equipment used to perform aircraft de / anti-icing are to be completed prior to the readiness date.

      (4) Pre-season anti-icing fluid laboratory fluid tests completed and reports posted on the Winter Operations Management Program website.

      (5) Stations must also have sufficient numbers of employees trained and certified at all levels applicable to their station in advance of their readiness date. Training may continue past ready date and throughout the season.

      (6) The plan is to be completed and approved prior to the ready date and maintained throughout the season.

         (a) The Station Winter Operations Plan resides electronically in the Winter Operations Management Program.

6. Dispatch-Network Operations Center (NOC)

   A. Within the United NOC structure, operational policies and procedures are defined, implemented and quality controlled. United Network Operations Center is responsible for reviewing and harmonizing with their related documents.

   B. Dispatch Procedures during Winter Operations:

      (1) As the Dispatcher, careful pre-planning, and evaluation of airport conditions must be made prior to releasing flights during winter operations. Once flights are en route to stations affected by winter operations, proper updating of pertinent safety information to the flight crews is required. This can include evaluating performance penalties for contamination on runways, or braking action reports, or known segments for severe icing conditions etc. Vigilance on the part of the Dispatcher cannot be underestimated when dealing with winter operations and safety of flight. The Dispatcher will delay as necessary any flight when conditions are such that icing could adversely affect safety of flight. In this case, the Dispatcher will consult with the Pilot in Command (PIC) and discuss concerns and current conditions. The Captain of the aircraft is the onsite evaluator and has the ultimate responsibility for safe operation of the aircraft. Good collaboration between both parties will ensure a safe outcome without unnecessary delay.

7. Station Supervision

   A. The station General Manager (or equivalent) must ensure and is responsible for local compliance with the ADAP. They are responsible to maintain a Station Winter Operations Plan and all operational documentation as described in this program to include but not limit to:

(1) **Validate all Deicing Training and Certifications records are in compliance.**

(a) Prior to any employee being given a deice task, the GM is responsible for developing a process to ensure all individuals are properly trained, certified and documented.

(b) Reference Airport Operations Business Manual (AOBM) 03-01-16 Training Records, Station Personnel and 03-01-17 Training Records, Vendors for responsibilities and procedures.

(2) Type I, II, III and / or IV Fluid receipt and acceptance records

(3) Documentation of deicing / anti-icing operations

(4) Equipment user checks

(5) Anti-icing laboratory reports completed and posted

(6) Continuous surveillance (self-observations)

(7) Maintaining daily station “count” calendar

(8) Identify a Deicing Coordinator

(9) Review Jeppesen deicing information

(a) This is typically on the 10-7 page. If updates are required, email the changes to: 10-7@united.com.

8. Station Implementation

A. Station Implementation (Ground Handler and Primary Deicing Provider are the same organization)

(1) The station General Manager (or equivalent) shall designate a Deicing Coordinator(s). The Deicing Coordinator(s):

(a) Is the primary local point of contact for deicing.

(b) Will be trained and certified in operational deicing.

(c) Is expected to maintain oversight of local winter operations procedures.

(d) Will monitor for temperatures (below 50°F / 10°C) and freezing precipitation.

(e) Will ensure staffing, equipment readiness and fluid inventory.

(f) Will ensure deicing personnel are trained and certified.

(g) Will develop a process that ensures all individuals are properly trained, certified and documented, prior to being given a deice task.

(h) Will coordinate planning and implementation of the ADAP, including preseason start-up and end of season shut-down.

1 Preseason starts the process of testing fluid no later than one month before their assigned ready date.

(i) Maintain Winter Operations Management Plan.

(j) Act as or designate the Shift Operational Person in Charge (OPC).

(k) They will obtain information and coordinate deicing operations with:

1 All Station Stakeholders (Station Ops, Ground Ops, Flight Ops, Tech Ops, Customer Service and Ground Equipment) and Network Operations Center (NOC).

a Aircraft exposed to cold, blowing snow (i.e. sustained winds greater than 25 knots) for extended periods of time (i.e. greater than five hours), may build up contamination in quiet areas of the aircraft. These areas include, but are not limited to: wing flap wells, wheel wells, outflow valves and engine inlets. Under these conditions, the local station management will need to coordinate with Technical Operations, Technical Operations Maintenance Control, Flight Operations and Deicing to determine:

i. If an inspection of these quiet areas is needed.

ii. When and where this inspection will take place.

iii. When and where the contamination removal will take place.

EXAMPLE: A plane has been parked overnight on the hangar line. During this time, the aircraft was exposed to a snow storm with four inches of accumulation and winds up to 30 mph. Upon arrival at the gate, the taxi crew lowers the flaps and discovers contamination in the seated area. This information is passed on to the flight deck. The flight deck coordinates with the deicing provider to lower the flaps once safely parked on the deicing pad. Upon completion of contamination removal and communication to the flight deck, the flight deck retracts the flaps and the aircraft continues standard Type I and IV fluid treatments.

2 Network Operations Center

3 Local weather entities, such as the National Weather Service, Air Traffic Control Tower, Liquid Water Equivalent systems and local Airport Terminal Information Service (ATIS).

a An LWES is an automated weather measurement system that determines the Liquid Water Equivalent (LWE) rate in frozen or freezing precipitation. The system then uses the LWE rate to determine the holdover time (HOT) and / or the check time (CT) for an anti-icing fluid.

b Operations Specification A323, Liquid Water Equivalent Systems (LWES) authorizes United Airlines to use these systems.

i. Flight Operations (PIC)

ii. Local Airport Authority

(2) The Shift OPC of deicing / anti-icing operation designated by station management; trained and certified in operational deicing / anti-icing must be on duty during de / anti-icing events and is responsible for:

(a) Validate the process that ensures all individuals are properly trained, certified and documented, prior to being given a deice task.

(b) Knowledge in all local policies and procedures included in Station Winter Operations Plan

(c) At stations with secondary contract deicing, oversight is required to ensure compliance with United's program.

(d) The deicing / anti-icing process has resulted in a clean aircraft per Title 14 of the Code of Federal Regulations 14 CFR Part 121.629.

NOTE: **The same individual may fill a dual role as Deicing Coordinator and Shift OPC. Only one person per shift must be identified as the OPC. Multiple people may carry the certification.**

(e) Ensure completion of station self-observation as required.

B. Station Implementation (Ground Handler is not the Primary Deicing Provider)

(1) The station General Manager (or equivalent) shall designate a Deicing Coordinator(s). The Deicing Coordinator must be trained and certified in oversight through the AO-DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT or AO-DEICING-SERVICE PROVIDER OVERSIGHT, and is responsible for providing the following:

(a) Ensure the third party deicing provider has met all requirements of the program.

(b) The OPC is trained in AO-DEICING-SERVICE PROVIDER OVERSIGHT.

(c) Adequate trained personnel, serviceable equipment and resources are available.

(d) Developing a process that ensures all individuals are properly trained, certified and documented, prior to being given a deice task.

(e) Oversight is required to ensure operational control and compliance with United’s program, including preseason start up and end season shut-down.

(f) The deicing / anti-icing process has resulted in a clean aircraft per Title 14 of the Code of Federal Regulations 14 CFR Part 121.629.

(g) Maintain the Winter Operations Management Plan (local procedures).

(h) Ensure completion of station self-observation as required.

(i) Act as or designate the Shift Non-Operational Person in Charge (Non- OPC)

(2) Shift Operational Person in Charge

(a) The Shift OPC of deicing / anti-icing operation designated by station management; trained and certified in operational deicing / anti-icing must be on duty during de / anti-icing events and is responsible for:

1 Validate the process that ensures all individuals are properly trained, certified and documented, prior to being given a deice task.

2 Knowledge in all local policies and procedures included in the Station Winter Operations Plan.

3 At stations with secondary contract deicing, oversight is required to ensure compliance with United's program.

4 The deicing / anti-icing process has resulted in a clean aircraft per Title 14 of the Code of Federal Regulations 14 CFR Part 121.629.

NOTE: **The same individual may fill a dual role as Deicing Coordinator and Shift OPC. Only one person per shift must be identified as the OPC. Multiple people may carry the certification.**

5 Ensure completion of station self-observation as required.

(3) They will obtain information and coordinate winter operations with:

(a) All Station Stakeholders (Station Ops, Ground Ops, Flight Ops, Tech Ops, Customer Service and Ground Equipment).

(b) Network Operations Center

(c) Local weather entities, such as the National Weather Service, Air Traffic Control Tower, Liquid Water Equivalent systems and local Airport Terminal Information Service (ATIS).

(d) Flight Operations (PIC)

(e) Local Airport Authority

(4) The Shift OPC of United's deicing / anti-icing operation must be on duty during deicing event.

(5) United Airlines Airport Operations General Managers of Line Stations training requirements.

(a) Defined as individuals not employed by the Ground Handler or Deicing Provider but having General Manager Oversight.

NOTE: **Required AO-DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT or AO-DEICING-SERVICE PROVIDER OVERSIGHT.**

(b) If desired, this individual may request to be certified as a Qualified Instructor – Deicing by contacting the United Airlines Senior Manager – Airport Operations Winter Operations.

(c) Ensure observations are completed.

9. Program Policy

A. General - This FAA approved deicing program is part of the Operations Specification A323 and must be complied with prior to dispatch, release or takeoff of United aircraft:

(1) Any time conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft.

(2) When frost, ice, or snow is adhering to wings, control surfaces, engine inlets, or other critical surfaces as determined by the specific aircraft manufacturer.

B. The Captain of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. The Captain of an aircraft is responsible for determining whether that aircraft is in condition for safe flight. Consequently, the ultimate responsibility for the determination that the aircraft is clean at take-off rests with the Captain.

C. Cold weather stations must ensure local procedures are in compliance with the ADAP, which is FAA approved. Any change to this specification cannot be approved locally and will require FAA and Senior Vice President Airport Operations approval prior to implementation.

D. The ADAP is a document that describes United's procedures and has been approved by United and the FAA. This program establishes the minimum criteria for United's operations. Compliance with these criteria are audited and documented internally by WHQQA, Airport Operation Quality Control and externally by the FAA, and associated results are evaluated. Continued surveillance audits are accomplished on an opportunity based on the quality assurance department scheduled station visits. Any other audits must be accomplished using the criteria spelled out in the ADAP.

E. Standard Aircraft International Ground Deicing Program is available for use for international third party deicing providers as allowed by current FAA-Approved Winter Update Notice N 8900 (current revision).

10. Service Providers

A. The term Service Provider throughout this manual is considered a ground handler performing the deicing function using this program unless stated otherwise.

B. Service Providers are other Air Carriers or Fixed Base Operators (FBOs) that are contracted by United to deice / anti-ice United's aircraft. These other Air Carriers or FBOs may be domestic or international.

C. United may contract with other Air Carriers (or FBOs) foreign or domestic using their deicing program as long as the program is approved by the FAA, their national regulatory agency and accepted by the CWOC.

D. United may contract with Service Providers that use other Air Carriers FAA approved deicing program, provided fleet differences training has been documented.

E. Service Providers at international stations may have their own approved deicing program that does not contain United specific requirements (fleet). United differences (aircraft) must accompany their program or follow the Standard International Aircraft Ground Deicing Program. The core of this program is the De / Anti-Icing Vendor Audit (DEVA) which audits the service providers program to SAE Aerospace Standards AS6285 Aircraft Ground Deicing / Anti-Icing Processes (current version) and AS6286 Aircraft Ground Deicing / Anti-Icing Training and Qualification Program (current version).

F. When using an International Service Provider's deicing / anti-icing program, United Station Management is still responsible of assuring compliance with United's requirements. Subject to airport authority restrictions, oversight is required and documented to ensure compliance to the ADAP.

NOTE: **Non-Airline Service Provider Deicing / Anti-icing programs have not been approved domestically by the FAA.**

G. Stations where there is no United management present (ex: diversion or charter station), the Captain of the aircraft in coordination with Dispatch of the United NOC is directly responsible for

a clean aircraft, and is the final authority as to the operation of that aircraft. The Captain of the aircraft will assume all operational control and follow stated procedures for resolution.

H. Back Up / Secondary Deicing Providers

(1) Stations that use a Back up / Secondary Service Provider, that Service Provider must be trained to United's program.

(2) Adhere to all ADAP polices.

(3) List the secondary provider on the winter operations station plan.

(a) Fluid in use is to be verified as approved by CWOC and pre-season test results forwarded to United Senior Manager – Airport Operations Winter Operations.

(b) Complete all associated back up Service Provider information (tanks, trucks, fluid, forward fluid test results…).

I. Stations that contract the use of a Service Provider's ground equipment, personnel must be trained to the identified differences of the ground equipment.

J. Service providers contracting the use of United equipment must have documented training.

11. Service Provider Evaluation

A. Station management must request evaluation and approval by the CWOC to use other Air Carrier, non-Air Carrier or Fixed Base Operator contract deicing services. United may recognize and authorize the use of another Air Carriers deicing program provided:

(1) The respective program meets or exceeds current SAE specifications.

(2) The program is determined to be equivalent to the United program and is approved by the CWOC.

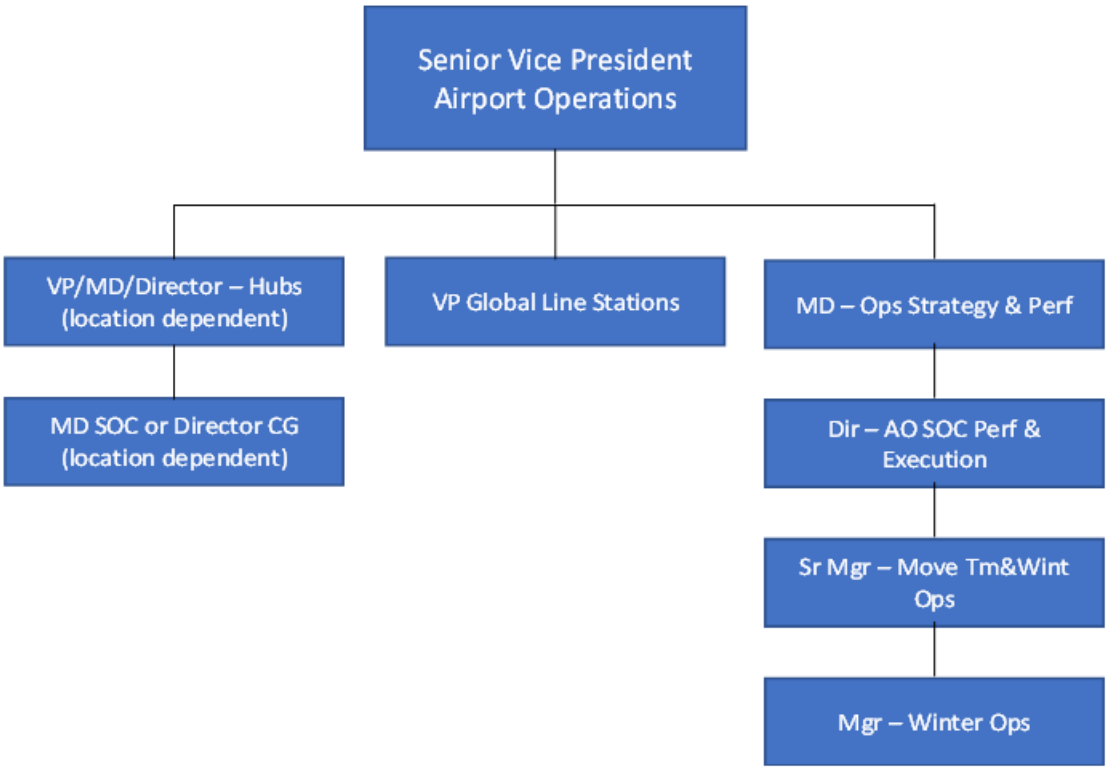
(3) The organization performing the deicing and the associated program to be followed are listed on the Station Winter Operations Plan.

B. Evaluation for compliance with United's procedures will be based on their FAA approval, ADAP and AS 6285.

C. All evaluated and approved vendors, including Other Airlines and Service Providers can be found on the Winter Operations Management Program.

12. Aircraft Deicing / Anti-Icing Program Organizational Responsibility Chart

13. Aircraft Deicing / Anti-Icing Program Operational Authority Organizational Chart



TRAINING

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TRAINING

1. General / Policy Overview

   A. This section contains information on training content and the various levels of training instructors and operators.

2. Purpose

   A. This section provides a listing of the various levels of instructor and operator training. It also covers training content to be presented in each training session.

3. Scope

   A. This information covers all United personnel and Service Providers who perform all deicing related activities on United aircraft.

4. Training Policy

   A. General:

      (1) All ground personnel involved in the deicing / anti-icing process, operation of equipment, material handling and acceptance must be appropriately trained and certified, including passing an assessment before accomplishing or directing these tasks for their area of responsibility.

      (2) The Flight Operations Standards and Training Department is responsible for facilitating training and maintaining the training records for Flight Crew in accordance with the Flight Operations Advanced Qualification Program.

         (a) Flight Operations Training content

            1 Use of Holdover Times (HOT).

            2 Aircraft deicing / anti-icing procedures, including inspection and check procedures.

            3 Communication procedures.

            4 Aircraft surface contamination and effects.

            5 Types / characteristics of deicing / anti-icing fluids.

            6 Cold weather pre-flight inspection procedures.

            7 Techniques for recognizing contamination on aircraft.

      (3) The United Network Operations Center (NOC) Senior Manager Flight Dispatch Training is responsible for facilitating and maintaining the training records for Dispatchers in accordance with the Dispatch Training program. Dispatch winter operations training curriculums are integrated in the Dispatch Training Manual.

         (a) Dispatch Training content

            1 Winter weather conditions.

            2 Runway conditions and FICONs.

3 Prohibited operations.

4 Clean aircraft concept.

5 De-ice and anti-ice procedures.

6 Holdover and allowance times.

(4) Initial certification and / or annual recurrent training of Ground, Flight and Dispatch operational personnel involved with aircraft deicing / anti-icing must be accomplished as outlined in this section and defined by applicable corporate training program in conjunction with the Corporate Winter Operations Committee (CWOC).

(5) Each Cold Weather Station must have a Qualified Instructor - Deicing Trainer (QI) to conduct local training.

(6) Training programs will be reviewed annually for any change in requirements by the CWOC.

(7) The United Operational Person in Charge (OPC) and the Station Deicing Coordinator in charge of the deicing / anti-icing personnel must have at least the same level of training as those personnel executing the process at the level applicable to the station.

(a) If your organization performs the deicing function you are required to have an operator's certification.

(b) If your station has a third party performing the function, you are required to have at a minimum SERVICE PROVIDER OVERSIGHT certification.

(8) United personnel can only be trained in deicing / anti-icing procedures by United trainers. Service Providers are not approved to train United personnel.

(9) Service Providers trained as a United Master Deicing Trainer may train their company Qualified Instructor – Deicing Trainers and 3rd party Qualified Instructor – Deicing Trainers in markets affiliated with their company operations with written approval from the UA CWOC core committee.

(a) Service Provider's local Qualified instructor – Deicing Trainer(s) certified by United are only allowed to train their own local personnel on the United procedures.

(10) Individuals transferring to a new station and holding a current deicing certificate must be evaluated by the local QI and re-trained as necessary at the new station to the required certificate level prior to deicing. Training shall include local deicing policies and procedures. The local United Deicing – Qualified Instructor must update the operator(s) record(s) in TakeOff Learning or an approved documentation process.

(11) Training certification will expire on November 01 of the following year.

(a) Certifications are based on the currently approved revision of this manual

(b) Any subsequent revisions will be trained once the revision has been published

(c) Training may take place in any form deemed appropriate and approved by the CWOC and is not limited to eLearning, bulletins or instructor led briefings.

5. Service Provider

A. Service Provider using United's deicing / anti-icing units or facilities must be trained by a United 2023 DEICING-MASTER INSTRUCTOR or 2023 DEICING-QUALIFIED INSTRUCTOR to operate company equipment.

B. Service Provider's training delivery must comply with the requirements of United's Aircraft Deicing / Anti-Icing Program (ADAP).

6. Training and Certification Records

A. United stations must use the applicable electronic Learning Content Management System (LCMS) for Trainers and Operators assessment. Any exception from the use of the LCMS assessment must be approved by the Core CWOC.

B. Domestic Flying partners, Ground Handling partners and any 3rd party deicing providers shall use the applicable United electronic Learning Content Management System (LCMS) for Trainers and Operators assessment. Any exception from the use of the LCMS assessment must be approved by the Core CWOC.

(1) When the Standard International Aircraft Ground Deicing Program is in use, the Provider will maintain their own training records in their system and the United personnel will be maintained in the United LCMS.

C. These records will be readily available for station use, FAA inspection, CWOC, Business Partner and Quality Assurance audits.

D. Annual recurrent training is required. Stations must also have sufficient numbers of employees trained and certified at all levels applicable to their station in advance of their readiness date. Training shall continue until all affected employees are complete.

E. Service Providers must document and maintain training records for operational deicers. The Service Provider's QI must be documented in the LCMS system for certification and documentation of training. At International locations the Service provider's certification must comply with the requirements as defined by the Standardized International Airline Ground Deicing / Anti-icing Program (SIAGDP) and DEVA audit (when applicable).

F. Service Provider Operational Deicers using United's program will be required to pass the WHQAT developed training material and paper test as required for applicable certification with a score of at least 90% when the LCMS is unavailable for use. Any missed questions must be reviewed. All Operational Deicers who fail to receive 90% or better will be required to repeat the deicing course and assessment.

(1) Documentation to be retained:

(a) Class roster

(b) Completed assessment with 90% or above passing score

(c) Copy of completion of OJT Checklist

G. All domestic service providers certifications are to be held in the United LCMS. Exceptions to be approved by the CWOC core committee.

7. Training Content

A. In accordance with 14 CFR Part 121.629, SAE AS6285 and Advisory Circular AC120-60 (current revision) training for personnel involved in the Winter Operations Program must be conducted annually and must include, but not be limited to the following:

(1) Effects of frost, ice, snow and slush on aircraft performance, including stability and control.

(2) Basic characteristics of aircraft deicing / anti-icing fluids.

(3) General techniques for removing deposits of frost, ice, snow and slush from aircraft surfaces and for anti-icing.

(4) Deicing / anti-icing procedures in general and specific measures to be performed on specific aircraft types including lessons learned from past winters and new procedures or development.

(5) Types of checks required and procedures.

(6) Deicing / anti-icing equipment operating procedures to include:

(a) Truck maneuvers

(b) Truck Operator responsibilities

(7) Safety precautions.

(8) Local station emergency procedures.

(9) Application and limitations of holdover time guidelines and ice pellet allowance times.

(10) Difference between adhering and non-adhering precipitation, e.g. what is acceptable and what is not.

(11) Visual standards of "clean" aircraft versus aircraft surface contaminated by unacceptable amounts of frost, ice, snow or slush.

(12) Communication procedures.

(13) Special provisions and procedures for Service Provider deicing / anti-icing (if applicable).

(14) Deicing / anti-icing record keeping.

(15) Environmental considerations e.g. where to deice, spill reporting and hazardous waste control.

(16) Procedures to be followed if the deicing / anti-icing operation is interrupted for any reason.

(17) Include any Local Airport requirements.

(18) Fluid Storage and Handling

8. Materials

A. Training materials are based on the United ADAP Manual.

(1) The following training materials will be reviewed annually by the CWOC at the end of the season and as notices are issued. This is to ensure all necessary elements of the ADAP

have been developed, properly integrated, coordinated and disseminated to all persons who have duties, responsibilities, and / or functions to perform in accordance with them.

(a) Trainer Facilitator Guide, (Winter Operations Aircraft Snow and Ice Removal)

(b) Student Participant Guide, (Winter Operations Aircraft Snow and Ice Removal)

(c) Electronic Media

(d) Learning Content Management System (LCMS)

(e) Service Provider Deicing / Anti-icing paper materials

9. Levels of Certification for Ground Personnel

A. The training / certification program covers seven different levels for deicing / anti-icing operations:

(1) 2023 DEICING-MASTER INSTRUCTOR

(a) ANNUAL

(2) 2023 DEICING-QUALIFIED INSTRUCTOR-NORTH AMERICA

(a) INITIAL

(b) RECURRENT

(3) 2023 DEICING-QUALIFIED INSTRUCTOR-NRT only (This certification is for NRT employees only)

(a) INITIAL

(b) RECURRENT

(4) 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

(a) ANNUAL

(5) 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

(a) ANNUAL

(6) 2023 DEICING-OPERATOR-NORTH AMERICA

(a) INITIAL

(b) RECURRENT

(7) 2023 DEICING-OPERATOR-NRT ONLY (This certification is for NRT employees only)

(a) INITIAL

(b) RECURRENT

(8) 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

(a) ANNUAL

(9) 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

(a) ANNUAL

(10) 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

(a) ANNUAL

(11) 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

(a) ANNUAL

B. Aircraft Deicing / Anti-icing Procedures

(1) The Annual Master instructor certification is intended to certify corporate instructors who will train and qualify their internal company qualified instructors and may also train and qualify deicing service provider qualified instructors hired as a third party or any certification as described in this training section. Qualified instructors will only train their local company operational and non-operational personnel as applicable to their certification.

(2) 2023 DEICING-MASTER INSTRUCTOR

(a) Annual Certification

1 Course certifies experienced deicing / anti-icing personnel to become a Master Deicing Trainer.

2 Training course includes classroom and practical training in procedures, required aircraft checks, fluid receipt and acceptance and equipment operation.

3 Global Learning or Corporate Winter Operations must certify the Master Instructor Deicing.

4 An assessment will be administered at the end of the classroom portion.

5 Master Instructor Deicing facilitates deicing classes, seminars, and workshops for both United employees and Service Providers. This includes certifying Qualified Instructors and Operational Personnel from United and Service Providers to United's standards.

6 The Master Instructor Deicing must be familiar with all deicing / anti-icing support facilities at United stations and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

7 Assists in the design, development and implementation of the deicing curriculum including student guides, facilitator guides, job aids, and reference materials. Serves as a subject matter expert to ensure the curriculum is current and utilizes the latest technology for participant learning.

8 Personnel must be trained on the use of unique systems such as deicing heaters, fluid mixing and dispensing systems, electric / hydraulic systems, etc.

9 The successful completion of the Master Instructor Deicing-Annual qualification will incorporate deicing certifications of:

a 2023 DEICING-MASTER INSTRUCTOR

b 2023 DEICING-QUALIFIED INSTRUCTOR

c 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

d 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT

e 2023 DEICING-OPERATOR

f 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT

g 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

(3) 2023 DEICING-QUALIFIED INSTRUCTOR-NORTH AMERICA

(a) Initial

1 Course certifies experienced deicing / anti-icing personnel to become a Qualified Instructor.

2 Training course includes classroom and practical training in procedures, required aircraft checks, fluid receipt and acceptance and equipment operation.

3 WHQAT or Master Trainer must certify the QI.

4 An assessment will be administered at the end of the classroom portion.

5 Upon successfully completing this course, United personnel may train other United operational personnel (including those who perform the deicing coordinator duties for their station) and Service Provider deicing personnel using United furnished training materials.

6 The QI must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

7 Personnel must be trained on the use of unique systems such as deicing heaters, fluid mixing and dispensing systems, electric / hydraulic systems, etc.

(b) Recurrent

1 Reviewing the United ADAP Manual

2 Reviewing United current training materials

3 Successfully completing the current deicing / anti-icing assessment

4 A Master Trainer must certify the QIs under the initial certification course, if none of the above conditions has been met.

5 The successful completion of the Qualified Instructor- Deicing Trainer-Recurrent qualification will incorporate deicing certifications of:

a 2023 DEICING-QUALIFIED INSTRUCTOR-NORTH AMERICA-INITIAL or RECURRENT as applicable

b 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

c 2023 DEICING-OPERATOR

d 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

NOTE: **These certifications will represent only the assigned station of the Qualified Instructor-Deicing Trainer. A QI shall not train an operator from a station he is not assigned to.**

(4) 2023 DEICING-QUALIFIED INSTRUCTOR-NRT ONLY

(a) Initial

1 Course certifies experienced Narita deicing / anti-icing personnel to become a QI.

2 Training course includes classroom and practical training in procedures, required aircraft checks, fluid receipt and acceptance and equipment operation.

3 WHQAT or Master Trainer must certify the QIs.

4 An assessment will be administered at the end of the classroom portion.

5 Upon successfully completing this course, United personnel may train other United operational personnel (including those who perform the Deicing Coordinator duties for their station) and Service Provider deicing personnel using United furnished training materials.

6 The QIs must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

7 Personnel must be trained on the use of unique systems such as deicing heaters, fluid mixing and dispensing systems, electric / hydraulic systems, etc.

(b) Recurrent

1 Reviewing the United ADAP Manual.

2 Reviewing United current training materials.

3 Successfully completing the current deicing / anti-icing assessment.

4 A Master Trainer must certify the QIs under the initial certification course, if none of the above conditions has been met.

5 The successful completion of the Qualified Instructor-Deicing Trainer-Recurrent qualification will incorporate deicing certifications of:

a 2023 DEICING-QUALIFIED INSTRUCTOR-NRT ONLY-INITIAL-RECURRENT as applicable

b 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

c 2023 DEICING-OPERATOR-NRT ONLY

d 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

(5) 2023 DEICING-OPERATOR-NORTH AMERICA

(a) Initial and Recurrent

1 Course certifies personnel who service and operate deicing / anti-icing equipment, personnel having direct responsibility for deicing / anti-icing crews and operations, the station Deicing Coordinator and the Operational Person(s) in Charge (OPC) for the designated station in North America.

2 Either a WHQAT / Master Trainer instructor or local Qualified Instructor using current United furnished training materials may conduct the course.

3 Includes classroom and practical training in procedures, equipment operation, fluid receipt and acceptance, and required aircraft post deicing checks (ref. ADAP Chapter 4 Ground Policy and Procedures).

4 An assessment will be administered at the end of the classroom portion of the training.

5 Personnel who successfully complete this course are certified to perform deicing / anti-icing operations and will be able to determine if aircraft meets requirements (ref. ADAP Chapter 4 Ground Policy and Procedures).

6 Personnel designated as Station Deicing Coordinator and OPC.

7 Personnel designated as having direct responsibility for deicing / anti-icing crews and operations.

8 Equipment operators.

9 All may re-certify for the designated station by:

a Viewing applicable videos.

b Successfully completing the current deicing / anti-icing assessment.

c Review of local operational procedures and equipment.

C. Deicing / Anti-icing fluids (Type I, II, III and IV) processing

(1) 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

(a) Annual Training

1 Conducted by WHQAT / Master Trainer using United furnished training materials.

2 Trains personnel who have responsibility for training others on the procedures to receive and accept all types of deicing / anti-icing fluids, to include:

a Fluid storage

b Fluid handling

c Fluid sampling

d Fluid testing

e Record keeping

3 Includes classroom and practical training.

4 Successful completion of the course and assessment.

5 Conducted by WHQAT or Master Trainer.

6 The successful completion of the Fluid Receipt and Acceptance Station Trainer qualification will incorporate deicing certifications of:

a 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

b This certification will represent only the assigned station of the Fluid Receipt and Acceptance Station Trainer. A Fluid Receipt Station Trainer shall not train an operator from a station he is not assigned to.

(2) 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

(a) Annual Training

1 Course certifies personnel who accept deicing / anti-icing fluids at the station to include:

a Fluid storage

b Fluid handling

c Fluid sampling

d Fluid testing

e Record keeping

2 Either a WHQAT / Master Trainer or a QI using current United furnished training materials may conduct the course.

3 Includes classroom and practical training in procedures, equipment operation and required fluid checks.

4 An assessment will be administered at the end of the classroom portion of the training.

5 Personnel who successfully complete this course are authorized to perform deicing / anti-icing fluid acceptance for their designated station.

(3) Acceptance of another 121 carrier FAA approved fluid receipt and acceptance program.

(a) An individual must be trained in fluid receipt and acceptance to receive fluids on behalf of United. If an individual is trained in another 121 Carriers FAA approved program,

they will be considered qualified to receive fluid on behalf of United if the following items are verified and met:

1 Verification of fluid appearance

2 Verification Freeze Point, BRIX or Refractive Index test was completed on the fluid and the results are within fluid manufacturer guidelines.

3 Documentation of acceptance is maintained along with applicable Certificate of Analysis.

(b) Local station leadership must verify employee accepting fluid on behalf of United has a training completion for the current season under the other airlines FAA approved program.

(c) For questions contact Manager Winter Operations.

D. Service Provider Oversight - Annual Training Course (Ground Handler is not the Deicing Provider)

(1) 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

(a) Annual Training

1 Course certifies personnel for oversight of Service Providers to ensure compliance with the United ADAP and certifies trainers to train to the OPC using Service Provider Level.

2 Training course includes training in procedures, required Mainline and Express aircraft checks, fluid receipt and acceptance, and equipment operation.

3 An assessment must be completed at the end of the lesson.

4 United personnel, upon successfully completing this course, are certified to function as an OPC in a station where the Service Provider is the primary provider.

5 The OPC must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

6 The successful completion of the 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA qualification will incorporate deicing certifications of:

a 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

b 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

c 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

d 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

e These certifications will represent only the assigned station of the 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA. An OPC Trainer shall not train an OPC from a station he is not assigned to.

(2) 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-NORTH AMERICA

(a) Annual Training

1 Course trains personnel for oversight of Service Providers to ensure compliance with the United ADAP.

2 Training course includes e-learning training in procedures, required aircraft checks, fluid receipt and acceptance, and equipment operation.

3 An assessment must be completed at the end of the lesson.

4 United personnel, upon successfully completing this course, are certified to function as an OPC in a station where the Service Provider is the primary provider.

5 The OPC must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

(3) 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

(a) Annual Training

1 Course certifies personnel for oversight of Service Providers to ensure compliance with the United ADAP and certifies trainers to train to the OPC using Service Provider Level.

2 Training course includes training in procedures, required Mainline and Express aircraft checks, fluid receipt and acceptance, and equipment operation.

3 An assessment must be completed at the end of the lesson.

4 United personnel, upon successfully completing this course, are certified to function as an OPC in a station where the Service Provider is the primary provider.

5 The OPC must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

6 The successful completion of the 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC qualification will incorporate deicing certifications of:

a 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

b 2023 DEICING-QUALIFIED INSTRUCTOR-FLUID RECEIPT AND ACCEPTANCE

c 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

d 2023 DEICING-OPERATOR-FLUID RECEIPT AND ACCEPTANCE

e These certifications will represent only the assigned station of the 2023 DEICING-QUALIFIED INSTRUCTOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC. An OPC Trainer shall not train an OPC from a station he is not assigned to.

(4) 2023 DEICING-OPERATOR-SERVICE PROVIDER OVERSIGHT-EUROPE AND PACIFIC

(a) Annual Training

1 Course trains personnel for oversight of Service Providers to ensure compliance with the United ADAP.

2 Training course includes e-learning training in procedures, required aircraft checks, fluid receipt and acceptance, and equipment operation.

3 An assessment must be completed at the end of the lesson.

4 United personnel, upon successfully completing this course, are certified to function as an OPC in a station where the Service Provider is the primary provider.

5 The OPC must be familiar with all deicing / anti-icing support facilities at the station and shall include the operation and safety aspects of facilities and equipment in the deicing / anti-icing training plan.

(5) Station Management

(a) In stations where the ground handler and primary deicing provider are the same, the General Manager must complete the Operational Deicer certification.

(b) In stations where the ground handler and primary deicing provider are not the same, the General Manager must complete (at a minimum) the Service Provider Oversight certification.

(c) In stations where a United GM oversees a third party ground handler and deicing provider, the United GM must complete (at a minimum) the Service Provider Oversight certification.

NOTE: **At United Airlines line stations, the Assistant General Manager (or equivalent) may fulfill this requirement.**

(6) Flight Operations Snowflake (supplemental)

(a) Annual Training

1 The requirements of this course will be designated and facilitated by the Flight Operations training organization.

2 Curriculum Includes

a Winter Operations Rules and Regulations

b Fluid Identification

c Mainline Aircraft Identification

3 Snowflake Operations requires successful completion of the e-learning lesson and assessment.

(b) Snowflake Certification also requires snowflake training from flight standards.

1 Snowflake Certification records to be maintained locally in the station.

GROUND POLICY & PROCEDURES

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GROUND POLICY & PROCEDURES

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GROUND POLICY & PROCEDURES

1. General / Policy Overview

   A. This chapter provides procedures for safe dispatch of United aircraft by Certified Ground Personnel during winter conditions.

2. Purpose

   A. This chapter provides directions for applying de / anti-icing fluids to United aircraft as well as subsequent communications with flight crews. It includes instructions for removing frost, ice, snow or slush from aircraft surfaces (deicing) and application of anti-icing fluids to provide time limited protection against re-freezing during periods of freezing precipitation (anti-icing) in accordance with Title 14 of the Code of Federal Regulations 14 CFR Part121.629.

3. Scope

   A. This information covers all United employees and Service Providers who perform all deicing related activities on United aircraft.

4. Ground Operation in Freezing Precipitation Policy

   A. No person may take-off an aircraft when frost, ice, or snow is adhering or reasonably expected to adhere to the wings, control surfaces, propellers, engine inlets, or other critical surfaces of the aircraft.

   B. Ultimate Responsibility

      (1) The ultimate responsibility for the determination that the aircraft is clean at take-off rests with the Captain of the aircraft (FAR 91.3).

   C. Repositioning to Remote Location for Deicing

      (1) When taxiing aircraft to a remote location to perform deicing / anti-icing the following shall be required upon request from flight deck:

         (a) Ice or snow accumulations are removed from any part of the airplane directly forward of the engines, or adhering to landing gear or nose steering cables.

         (b) Door interiors are clean of ice and snow and closed prior to taxi.

         (c) Engine and APU pre-start / preheat requirements are accomplished for the specific airplane type.

         (d) Forward and side cockpit windows must be clear with no obstructions to visibility to the front or sides.

   D. Deicing and anti-icing must be accomplished when freezing precipitation exists and the precipitation is adhering or is reasonably expected to adhere to the aircraft surfaces at the time of dispatch. The deicing / anti-icing procedure is performed in a one-step or two-step process.

      (1) One-step deicing / anti-icing is carried out with a heated deicing / anti-icing fluid. The fluid used to deice the aircraft remains on aircraft surfaces to provide limited anti-ice capability.

         NOTE: **Not recommended repetitively, because of fluid residue accumulation problems.**

(2) Two-step deicing / anti-icing consists of two distinct steps. The first step, deicing, is followed by the second step, anti-icing, as a separate process. Unheated (or heated) anti-icing fluid is applied to protect the relevant surfaces thus providing maximum possible anti-icing capability.

(a) The selection of a one or two-step process depends upon weather conditions, available equipment, fluids and the holdover time to be achieved.

NOTE: **Two-step is recommended.**

1 Holdover Time (HOT) is the estimated time deicing / anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the surfaces of the aircraft. HOT begins when the final application of deicing / anti-icing fluid commences and expires when the deicing / anti-icing fluid is expected to lose its effectiveness. HOT is determined by the flight crew using current FAA holdover tables and current freezing precipitation rates.

2 In the event HOT has been exceeded as determined by the Flight deck, the aircraft (including wings, control surface and other critical surfaces) are re-deiced / anti-iced (as needed) and a new hold over time determined or wing check done within 5 minutes of starting takeoff run.

CAUTION: **WHEN PERFORMING HEATED DE / ANTI-ICING FLUID IN A ONE (1) OR TWO (2) STEP PROCESS, THE APPLICATION OF THE HEATED MATERIAL MUST ENSURE ALL THE CONTAMINATION IS REMOVED AND THE SURFACE HAS RECEIVED THE REQUIRED AMOUNT OF HEATED FLUID TO PROPERLY APPLY A SINGLE STEP HOLDOVER TIME OR SECOND STEP ANTI-ICING APPLICATION.**

5. Deicing Procedures

A. General

(1) All ground personnel involved in the deicing / anti-icing process, operation of equipment, material handling, material acceptance and testing must be appropriately trained and certified before accomplishing or directing these tasks for their area of responsibility.

(2) Deicing is defined as the method by which frost, ice, snow or slush is removed from the aircraft in order to provide clean surfaces. Deicing is accomplished by certified operational deicer personnel using one of the following methods according to procedures defined in this document.

(a) Deicing fluids inclusive of:

1 Water (CWOC must give authorization prior to use)

2 Heated mixture of water and Type I Fluids (must be diluted)

3 Heated mixture of water and Type II, III or IV fluids (or neat fluids)

NOTE 1: **Type III fluids can be used to deice mainline aircraft. Type III fluid, used for Anti-ice, is designed for use on smaller commuter airplanes with a slower takeoff speed.**

NOTE 2: **Deicing fluids do not protect the aircraft surfaces from in-flight icing.**

NOTE 3: **Heated and diluted Type III and IV are not normally used domestically.**

(b) Forced air (with or without fluid)

(c) Mechanical (Manual) Methods

(d) Infrared

B. Aerodynamic Considerations

CAUTION: **DUE TO AERODYNAMIC PERFORMANCE REQUIREMENTS, TYPE I FLUIDS SUPPLIED AS A CONCENTRATE MUST NOT BE USED UNDILUTED. FOR THE SAME REASON, NO TYPES OF FLUIDS SHOULD BE USED BELOW THE LOWEST OPERATIONAL USE TEMPERATURES (LOUT) SPECIFIED IN THE APPROPRIATE USE TABLES.**

(1) Certified deicer personnel will determine the fluid mixture for one step deicing / anti-icing with regard to desired HOT dictated by outside air temperature (OAT) and weather conditions prior to fluid application on the aircraft.

(2) Certified deicer personnel will determine the fluid mixture for the first step (deicing) of the two-step process (deicing / anti-icing) with regard to OAT. Choose the second step anti-icing fluid with regard to desired HOT dictated by OAT and weather prior to fluid application on the aircraft.

(a) Special consideration should be given to the LOUT, the lowest operational use temperature. The LOUT is the lowest temperature at which a de / anti-icing fluid will adequately flow off aircraft critical surfaces and maintain the required anti-icing freezing point buffer. The LOUT is fluid and concentration specific and can be found on the fluid specific tables. Manufacturers state that a fluid must not be used when the outside air temperature (OAT) is below the LOUT of the fluid.

(3) The certified deicer personnel will perform the second step before the first step fluid fails (typically start within 3-5 minutes).

(4) The HOT provided by the applied fluid is equal to or greater than the estimated time from start of anti-icing to the start of takeoff. The HOT is based on existing weather conditions as determined by the flight crew.

(5) When performing two-step deicing / anti-icing, the freezing point (FP) of the fluid being used for the first step must not be more than 5ºF (3ºC) above the outside air temperature (OAT). This is not typically practiced.

(6) The FP of the heated (to 140ºF / 60ºC minimum at the nozzle) Type I fluid mixture used for either one step deicing / anti-icing or as a second step anti-icing in the two-step operation must be at least 18ºF (10ºC) below the OAT. Maximum temperature shall not be above 190º at the tank.

(7) The FP of the Type II, III or IV fluid mixture used for the second step (anti-icing) in the two-step operation must be at least 13ºF (7ºC) below the OAT. This typically applies to blended Type II.

C. Deicing with Fluids – Removal of Frost, Slush, Snow and Ice

(1) This section establishes the procedure to be used by certified operational deicer personnel for removal of frozen precipitation (frost, ice, snow and slush) from aircraft surfaces using fluids.

(2) Type I / Type IV Critical Surfaces

(a) For the purposes of Type I (De-Icing) and Type IV (Anti-Icing) fluid application, the aircraft's critical surfaces are divided into two groups. The first group is Type I Critical Surfaces, the second group is Type IV Critical Surfaces. All critical surfaces of an aircraft need to be clean prior to takeoff. By clean the following is referred; all critical surfaces must be clear of adhering frost, ice, snow or slush with some pre-defined exceptions.

(b) The purpose of defining two separate critical surface groups is to identify which critical surfaces of an aircraft do not require Type IV fluid application. Industry experience has shown that Type IV fluid application is not effective and / or required on some critical surfaces of an aircraft.

(c) For example, application of Type IV fluid on the vertical stabilizer and rudder of an aircraft is not as effective due to the 90 degree vertical surface angle which allows the fluid to fall to the ground due to gravity shortly after its application, also, these surfaces collect less frost, ice, snow or slush for the same reason. Similar scenario occurs on the aircraft fuselage which has variable surface angles. Industry experience has shown that for Type IV fluid to work effectively, the fluid must remain in the intended surface just prior to takeoff. Industry experience has also shown that applying Type I and following the FAA Hold Over Tables is sufficient to ensure these critical surfaces remain clean.

(d) Other critical surfaces such as the wings, flaps, slats, ailerons, horizontal stabilizer, and elevators which are directly responsible for the aerodynamic lift of the aircraft collect more frost, ice, snow or slush due to the 180 degree horizontal surface angle. These surfaces do require Type IV fluid application. Application of Type IV on these surfaces are more effective because the applied fluid remains on the surfaces prior to takeoff as intended.

(e) Type I Critical Surfaces

1 These critical surfaces require Type I fluid application and respective FAA holdover time guidelines apply.

a Wing Structure

i. Flaps

ii. Slats

iii. Ailerons

iv. Winglets

b Tail Control Surfaces

i. Horizontal Stabilizer

ii. Elevator

iii. Vertical Stabilizer

iv. Rudder

c Pitot Tubes

d Static Ports

e Engine Inlet

f Air Conditioning Inlets / Outlets

g Landing Gear

h Gear Doors Wheel Wells

i Fuel Tank Vents

j Fuselage

k Ram Air Intakes

l APU inlets and exhausts

m Radome

(3) Aircraft Surfaces Evaluation

(a) Under freezing precipitation conditions, the certified operational deicer personnel on the ground, or upon request from the flight crew or determined by the Operational Person in Charge (OPC), will make a visual inspection for contamination on all aircraft surfaces inclusive of:

1 Wings – visually check for ice, slush, snow or frost. Some coating of frost (1/8 inch) may be permissible on wing tank lower surfaces cold-soaked by fuel.

2 Control surfaces – visually check for ice, slush, snow, or frost. Some coating of frost (1/8 inch) may be permissible on wing tank lower surfaces cold-soaked by fuel.

3 Engine inlets – visually check for ice, snow and the fan is free to rotate as accessible.

4 Tail – visually check for ice, slush, snow, or frost.

5 Pitot Tubes, Static port, Ram-air intakes for engine control and flight instruments – Clear of ice, frost, snow and slush.

NOTE: **Ice ridges may form on the nose of the fuselage while on the ground. These ridges will disrupt air flow into the pitot tubes and can result in false measurements. All contamination must be removed from this area.**

6 Other types of instrument sensor pickup points – Clear of ice, frost, snow and slush, protective covers.

7 Fuel vents – Clear of ice, frost, and snow. Outflow valves clear and unobstructed.

8 Fuselage / Nose – Clear of ice and snow adhering or expected to adhere.

WARNING: **FAILURE TO ENSURE THE AIRCRAFT IS FREE OF CONTAMINATION WILL RESULT IN DECREASE OF LIFT, INCREASE IN DRAG AND REDUCES AIRCRAFT STABILITY.**

(b) Once contamination has been identified the aircraft will need to be deiced. Follow configuration, deicing / anti-icing and documentation procedure as defined within the program.

NOTE: **All aircraft fleet types must be configured by trained personnel prior to deicing / anti-icing.**

D. Aircraft Configuration

(1) Only trained and certified personnel are allowed to configure the aircraft.

(2) Positive confirmation of aircraft configuration by operational deicer certified personnel is required before the start of any deicing operations.

(3) Refer to the fleet specific Aircraft Maintenance Manual (AMM) or Aircraft Flight Manual (AFM) for required procedures.

(4) The OPC must ensure the local station process for identifying certified personnel to perform this function.

E. Overnight / Early Morning Configuration

(1) The process for configuring aircraft for early morning departures will be assisted by Flight Operations the night before.

(2) Aircraft are considered configured for deicing if the following criteria can be validated.

(a) The aircraft was a remainder (RON) overnight in the station.

(b) The APU is not running.

1 This is confirmed by:

a Sensing pressure and heat from the outflow valve and

b Hearing the “running”

(c) Contact Operations and Tech Ops to verify

1 No work is being performed on the aircraft.

2 No work has been performed on the aircraft overnight taking it out of configuration and not returned to configuration.

3 No irregularities have occurred leaving the aircraft out of configuration.

(3) Once the scheduled departure is under 60 minutes, the flight deck must be checked and verified the flight crew has not begun their checks.

(a) If less than 60 minutes and no flight crew is present, de / anti-icing may begin.

F. Spraying Recommendations

(1) Spray Selection

(a) Selecting the correct spray gun nozzle / setting which best fits the weather conditions will reduce the effort required and minimize fluid consumption. General guidelines for applying fluids are from the highest point to the lowest point allows for maximum fluid performance (see section G. Application Techniques for further instruction).

1 Frost - Use the fog or light mist setting.

2 Snow - Use the smallest solid stream setting possible.

3 Ice - Use the smallest solid stream setting possible. Attempt to work the ice loose from the aircraft skin.

NOTE: **In heavy snow, ice or windy conditions it may be necessary to use the higher flow settings.**

(2) For maximum effectiveness and minimum consumption, the deicing solution should be heated to a temperature between 140ºF and 180ºF. Establishing the temperature drop (at nominal flow rates) between the last monitored temperature point in the plumbing chain and the nozzle is sufficient. If Type I fluid is measured below 150ºF (tank location) notify flight deck that Holdover Times do not apply for Type I one step applications.

CAUTION: **MAXIMUM TANK TEMPERATURE IS 190ºF (87ºC).**

(3) Wind Precautions

(a) Wind conditions affect the usage as wind cools the fluid faster and distorts the stream. When deicing the aircraft in a strong wind, use these guidelines:

1 Deice the aircraft from an upwind position. When driving around the aircraft direct the fluid with the wind and let the wind help carry the fluid to the flight surfaces.

2 Apply fluid from as close to the surfaces as permissible.

3 Determine the wind direction before deicing to avoid spraying directly into the wind.

4 Use a coarse stream in the wind to prevent airborne mist.

(4) Clear Ice Precaution

(a) Clear ice can form on aircraft surfaces, below a layer of snow or slush. It is critical that surfaces are visually checked following each deicing operation, to ensure that all deposits have been removed.

(b) Wing temperatures lower than OAT may be associated with clear ice build-up and can occur when large quantities of cold fuel remain in wing tanks during the turnaround / transit. Subsequent refueling may not be sufficient to cause a significant increase in fuel temperature.

NOTE: **Clear ice is distinct from Cold Soak Fuel Frost (Non-Environmental Frost) on upper wing surface.**

(c) Pay particular attention to the possibility of Clear Ice formation when frost or ice is present on the lower surface of either wing.

(d) Clear Ice forms during freezing drizzle or light freezing rain weather conditions. The use of anti-icing fluid (Type II, III or IV) is strongly recommended to extend protection (holdover) time.

(e) When Clear Ice has been identified it must be removed through the deicing process.

G. Application Techniques

(1) Heated fluids should be applied close to the surface of the aircraft skin to minimize heat loss. The heat in the fluid effectively melts any frost, as well as light deposits of slush, snow, and ice. Heavier accumulations require the heat to break the bond between the frozen deposits and the structure; the hydraulic force of the fluid spray is then used to flush away the residue. The deicing fluid will prevent re-freezing for a period of time depending on aircraft skin temperature, OAT, the fluid used, liquid water content and the weather.

(2) Apply enough fluid to remove the ice and snow. Do not drench or wash the aircraft. Wait one (1) to two (2) seconds for the heated fluid to work and dissipate the ice and snow.

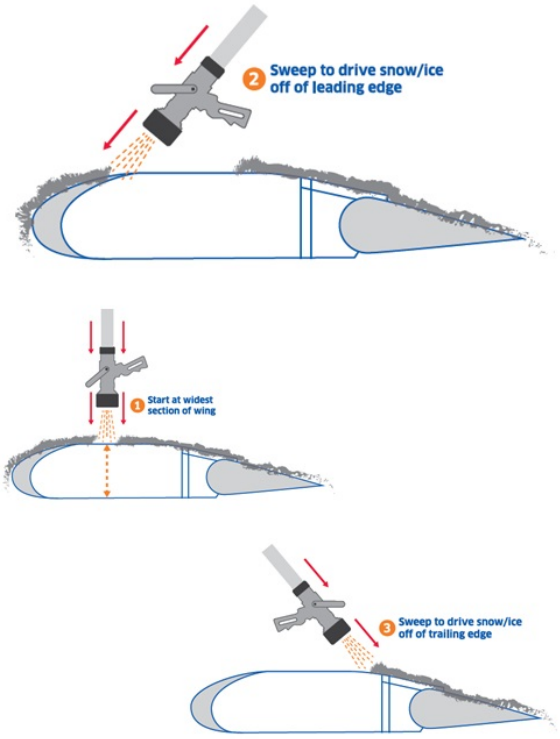
CAUTION: **WHEN PERFORMING HEATED DE / ANTI-ICING FLUID IN A ONE (1) OR TWO (2) STEP PROCESS, THE APPLICATION OF THE HEATED MATERIAL MUST ENSURE ALL THE CONTAMINATION IS REMOVED AND THE SURFACE HAS RECEIVED THE REQUIRED AMOUNT OF HEATED FLUID TO PROPERLY APPLY A SINGLE STEP HOLDOVER TIME OR SECOND STEP ANTI-ICING APPLICATION.**

(3) Apply fluid in sweeping motion. Do not hold the nozzle in one place waiting for the snow to disappear, rather make several sweeping motions, or roll the fluid over the surfaces.

(a) Several techniques are available, including the following:

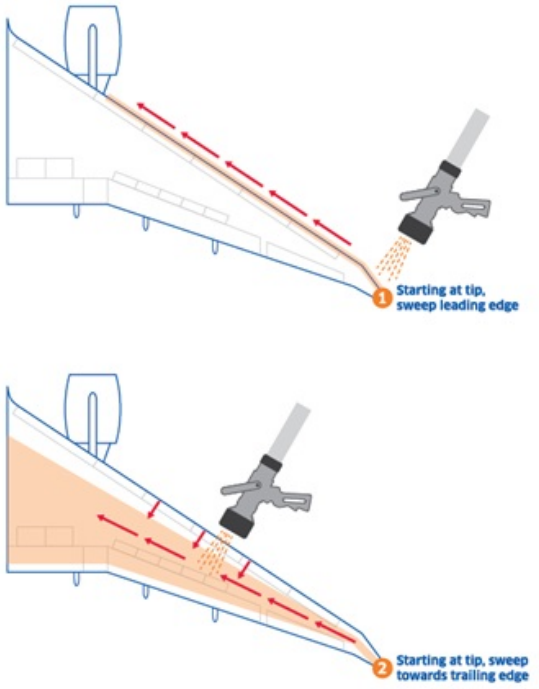
1 Apply fluid to the high point of the surface camber with a sweeping motion and let the fluids run down the aircraft surfaces, both leading and trailing edges. (see Figures 1-3 below).

FLUID APPLICATION TECHNIQUES



2 A sweeping motion back and forth from along the leading edge working toward the trailing.

FLUID APPLICATION - SWEEPING MOTION



(4) The position of the nozzle must be at a high angle (45º or more) above the surface to prevent forcing contamination in aerodynamically quiet areas, cavities, gaps and under flaps.

(5) Be aware of the various “no spray areas” on each aircraft.

H. Vehicle Operations

(1) Safety

(a) Any person riding in an open basket must wear and use a Full Body Fall Restraint Harness / Lanyard.

1 Any person riding in an enclosed basket must use the seatbelts provided.

(b) Any person riding in the open basket during windy or gusty deicing conditions must wear goggles as deicing fluids can be irritating to the eyes. Eye protection is required during application.

(c) In an emergency requiring immediate shutoff of the auxiliary engine, and fluid heater, activate emergency shutoff located throughout the chassis cab, deicing basket, and deicer body.

(2) Fire Suppression System

(a) The location of all immediate release actuators (manual action) and automatic detection system in an emergency requiring immediate shutoff of the auxiliary engine and fluid heater.

(3) Emergency Stop – In an emergency requiring immediate termination of all boom movement, fluid pumping and operational drives. Push an emergency stop button located in the basket, cab, or at the ground control panel.

(a) The location of all emergency stop switches for the local station equipment will be trained in the initial equipment operator training.

(4) Wind Precautions – To reduce the risk of employee injury caused by high winds while working in the bucket / enclosed operators compartment of a deicing vehicle a placard will be installed on all United owned and operated de-icing vehicles. Ground Handlers will follow their specific company policies or consult with the deicing truck manufacturer.

(a) **WIND GUST** is the maximum 3-second wind speed (in knots) forecast to occur within a 2-minute interval at a height of 10 meters. Wind gust forecasts are valid at the top of the indicated hour.

(b) **WIND SPEED** is the expected 10-meter sustained wind speed (in knots) for the indicated hour.

(5) Transmission items

(a) Brakes

1 Primary – check for pedal travel and for a non-slip foot pad on the pedal.

2 Parking Brake – check for holding action. Check must be made with engine running at idle speed by placing unit in gear.

(b) Engine status lights and / or gauges (i.e. oil pressure) – visually verify indicator light is working and normal, or gauge is working and in proper range.

(c) Steering – check for excessive play (rotate steering wheel from side to side).

(d) Controls / Shift quadrants – check for excessive wear-plate, looseness of control handle(s), and placards.

(e) Fluids – check fuel quantity, engine oil, and coolant.

(f) Hydraulic plumbing – check for obvious leaks.

NOTE: **Always refer to local guidelines for local equipment.**

(6) Electrical items

(a) Lights – check for operation (headlights, brake / tail, clearance, work etc.).

(b) Horn – check for operation, location accessible from operation seat.

(c) Defroster / Defogger – check operation.

NOTE: **Always refer to local guidelines for local equipment.**

(7) Body / Frame items

(a) Windows / Windshield – clean, free from cracks.

(b) Windshield Wipers – check operation wipers / washer.

(c) Doors – check handles, latches, proper operation.

(d) Mirrors – clean, unbroken, properly adjusted.

(e) Steps, Floors and Work Surfaces – clean, serviceable non-slip surfaces, and free from debris.

(f) Tires – visual check for inflation, tread.

(g) Handrails / Guardrails / Hand holds / Stops – check for defects.

(h) Boom - check for operational defects, cracks and missing parts.

CAUTION: **WHEN THE VESTERGAARD BETA UNIT IS IN USE, PHYSICALLY ENSURE THE TELESCOPING BOOM PROXIMITY SENSORS (E.G., "TUSKS") ARE NOT ICED UP.**

(i) Operational Placards – check to ensure placards are clean and legible. Replace if necessary.

(j) Other obvious defects or damage and other items, such as rollers, stabilizers, lubrications, latches, etc.

(8) Heaters – Heater Gauges – Deicing fluids must be heated to a minimum of 140° F and a maximum of 180°F at the nozzle. All temperature gauges that display fluid temperatures at the nozzle should be monitored for compliance.

(9) The recommended starting point for application is the captain side wing tip following a clockwise direction around the aircraft when using a single truck and the facility allows this.

(a) When multiple trucks are used to deice an aircraft, one truck will be assigned as the lead truck by the dispatcher and have the additional responsibility of ensuring all other trucks working the individual flight have completed the process. This function may also be completed by independent personnel provided the same process is followed.

(b) When driving a truck around aircraft, drive under 4 miles per hour.

(c) When positioning equipment (truck, tower or boom) up to the aircraft, never position under the wing or tail section.

(d) While deicing / anti-icing, be aware of the boom position in relation to the aircraft at all times.

NOTE: **Ensure boom telescoping tusks (if present) are movable and not frozen.**

(e) While deicing / anti-icing, the deicing vehicle (chassis) must maintain a minimum 5 foot clearance from the aircraft.

(f) While driving a deicing vehicle, if you cannot see through the window due to fluid steam, spray or falling precipitation, stop the vehicle until conditions impairing your vision have cleared.

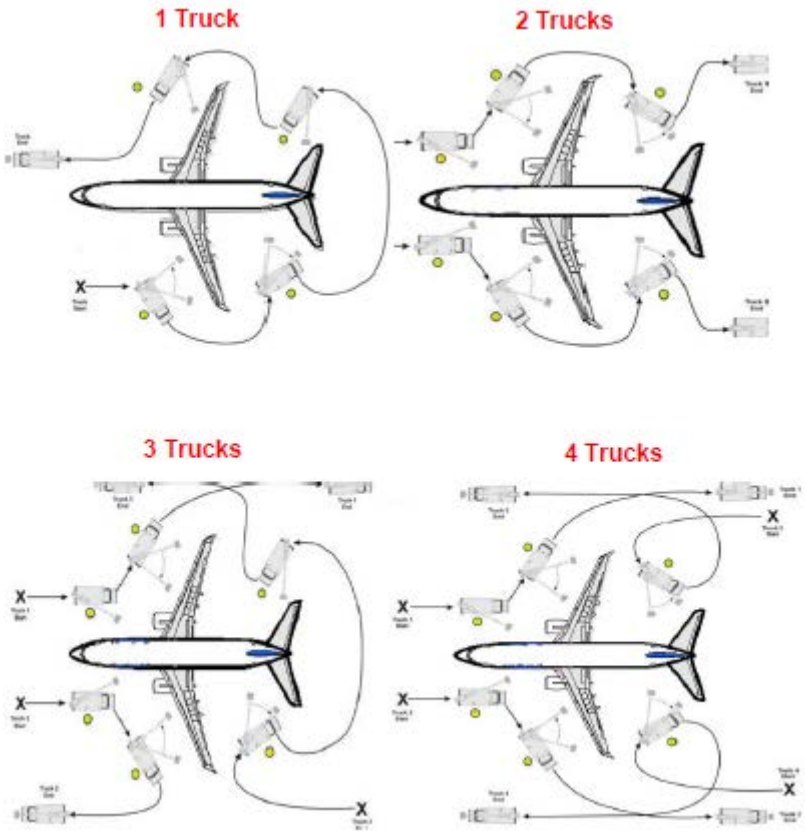
(g) When a two man crew is operating a deicing truck the basket operator must establish and maintain positive communication with the vehicle driver.

NOTE: **There are certain instances where other safe operating strategies may apply, depending on the local environment.**

(h) If the deicing is interrupted for any reason, completely repeat the process.

EXAMPLE: During a single truck operation, the truck depletes its Type IV supply prior to completing the application. Upon returning, the truck must start at the beginning of the first step. The flight deck must be notified of the situation prior to leaving the aircraft.

SAMPLE DRIVE PATTERNS



CAUTION: **THE REPEATED APPLICATION OF TYPE II, III OR IV (DURING REPEATED ONE-STEP PROCESS) MAY CAUSE RESIDUES TO COLLECT IN AERODYNAMICALLY QUIET AREAS, CAVITIES AND GAPS. THE APPLICATION OF HOT WATER OR HEATED TYPE I FLUID IN THE FIRST STEP OF THE DEICING / ANTI-ICING PROCESS WILL MINIMIZE THE FORMATION OF RESIDUES. RESIDUE MAY RE-HYDRATE AND FREEZE UNDER CERTAIN TEMPERATURE, HIGH HUMIDITY AND / OR RAIN CONDITIONS AND MAY BLOCK OR IMPEDE CRITICAL FLIGHT CONTROL SYSTEMS. THESE RESIDUES MAY REQUIRE REMOVAL.**

I. Water Deicing

NOTE: **A Corporate Winter Operations Core (CWOC) Committee Member must approve this procedure prior to implementation.**

(1) Water heated to 140ºF (60ºC) minimum at the nozzle can be used as a one-step deicing procedure in a hangar or outside only if the following conditions are satisfied.

(a) The OAT must be 34ºF stable and on the increase during the operation.

(b) There must be no active freezing precipitation during the operation.

(c) There must be no cold soak condition of the aircraft as evidenced by no adhesion of ice, snow, frost or slush anywhere on the aircraft surface and by no freezing of the water during the operation.

J. Forced Air and Forced Air / Fluid Deicing

WARNING: **THIS DEICING OPERATION SHOULD BE PERFORMED WITH THE AWARENESS OF POSSIBLE PROJECTILE HAZARD. DEICING SHOULD NOT BE PERFORMED WITH FORCED AIR OR FORCED AIR / FLUID WHENEVER SIGNIFICANT PROJECTILES ARE LIKELY TO BE PRODUCED. USE STANDARD DEICING / ANTI-ICING PROCEDURES AS A REFERENCE FOR ACCEPTABLE SITUATION.**

(1) Deicing unit shall be used with the forced air nozzle positioned at least 6 feet from the aircraft surfaces.

(2) Never place the forced air nozzle perpendicular to the aircraft.

(3) Keep the nozzle at a low angle to aircraft surfaces.

(4) Do not direct the air nozzle at the windshield or side windows.

(5) When removing ice, snow or slush from aircraft surfaces care should be taken to prevent it from entering and accumulating in aerodynamically quiet areas such as control surface hinge areas or from entering engine inlets.

(6) Forced Air only may not remove all adhering contaminants and therefore must be followed by an approved application of Type I fluid.

(7) When removing ice, snow or slush from the landing gear area and wheel well area with Forced Air, care should be taken as debris may cause damage to components.

(8) Forced Air / Fluid can be used to remove or assist in the removal of adhering frozen contaminants in non-active precipitation.

(9) Under active precipitation, Forced Air and Forced Air / Fluid must be followed by the general deicing / anti-icing process.

K. Non-Adhering Dry, Frozen Precipitation

(1) Under specific conditions of falling freezing precipitation, a deicing and / or anti-icing operation may not be required. Under these conditions the precipitation will be determined as Non Adhering. The conditions are:

(a) Ambient temperatures are generally below -10°C (14°F)

(b) Snowfall (or Ice Crystals) is dry and light

(c) Any contamination will blow off on aircraft surfaces under light wind or while taxiing

(2) The Flight Deck has the responsibility to determine if the precipitation is adhering and may use observations from Deice Personnel and / or Snowflake to assist in making this determination. When the conditions in the above section are present the frozen

precipitation will swirl as it blows across the wings. This is evidence that the frozen precipitation is not adhering to the aircraft.

(3) Several processes may be used to determine adherence.

(a) The primary resource will be to have the deice personnel make an observation from an elevated position paying particular attention to the defined critical areas.

1 The deice personnel will notify the flight deck if unable to determine if precipitation and contamination are adhering.

(b) If available, unheated Forced Air will be used to blow off accumulated snow in order to help the flight deck make a determination on adherence. If the contamination is easily removed and no contamination remains, no fluid needs to be applied to the aircraft and the Flight Deck will complete a nose check prior to takeoff.

(c) The Flight Deck will make related observation while conducting a walk around. When available, use the passenger loading bridge platform for an elevated view and cabin window to observe wing conditions.

NOTE: **Refueling with fuel warmer than wing skin temperature may cause previously non-adhering precipitation to adhere. Flight Deck will monitor the tank fuel temperature, an increase of >+5°C will require further evaluation.**

CAUTION: **IF USING HEATED FORCED AIR, A TYPE I APPLICATION IS REQUIRED.**

L. Non-Adhering Dry Accumulation on the Aircraft

(1) Under the same conditions in section K, there may be an accumulation of snow on aircraft surfaces (ex. Snow on an aircraft over night). Use the following process to make a determination of adherence.

(a) The primary resource will be to have the deice personnel make an observation from an elevated position paying particular attention to the defined critical areas.

1 The de-ice personnel will notify the flight deck if unable to determine if precipitation and contamination are adhering.

(b) If available, unheated Forced Air will be used to blow off accumulated snow in order to help the flight deck make a determination on adherence. If the contamination is easily removed and no contamination remains no fluid needs to be applied to the aircraft and the Flight Deck will complete a nose check prior to takeoff.

(2) Under this condition it is extremely important to verify there is adhering contamination beneath the visible accumulation on the entire aircraft.

(a) Use of unheated forced air may be the only process to guarantee this condition.

(b) When activated “Snowflake” personnel will give guidance.

M. Manual Methods

(1) Use of squeegees, brooms or ropes, can perform removal of snow and ice manually. These manual removal methods are more time consuming than using deicing fluid; however, they will reduce deicing fluid usage and can be used on overnight or long-turn aircraft.

NOTE 1: **Special care must be taken in areas of carbon fiber vertical and horizontal stabilizers, flight control surfaces, wing and fuselage skin, and engine fan cowls because their graphite fiber / epoxy construction is very prone to impact damage, which may not be visible externally.**

NOTE 2: **Be careful when removing ice and snow from fuselage, wing and tail surfaces, as protruding items such as vortex generators, lights, antennas, or static wicks could be damaged.**

(a) Manual methods are most effective with light, dry snow accumulations. Not all the snow can be removed; however, the major portions of narrow body wings and fuselage can be reached as follows:

(b) Using a maintenance lift truck, deicer or similar equipment to gain access, pull the snow off the surfaces. Do not attempt to walk or stand on the aircraft.

(c) Maneuver the vehicle along the leading and trailing edges, removing as much snow as possible.

(d) A squeegee with non-marking hard rubber edge works best. However, stiff bristle brooms may be used. Any metal surfaces on the broom or squeegee including attaching hardware must be padded adequately to prevent damage to aircraft surfaces.

(e) In addition to removing snow from the wings, a one-half inch rope with knots tied approximately two to three feet apart can be used to remove snow from the fuselage. Place the rope over the fuselage and with a person on each side, move the rope back and forth in "sawing" motion while slowly moving along the length of the aircraft.

(2) Remove the remaining snow and ice with deicing fluid.

NOTE: **Deicing and Snow Removal Alternatives require the same record keeping and pre-takeoff check requirements as the general deicing / anti-icing procedures.**

6. Anti-icing Procedure

A. General

(1) The Anti-icing procedure provides protection against the formation of frost or ice and accumulation of snow and slush on clean surfaces of the aircraft for a limited period of time (HOT). Anti-icing fluids include:

(a) Mixtures of water and Type I fluids (the HOT for this process is very limited)

(b) Concentrates (undiluted Neat) or mixtures of Type II, III or IV fluids and water.

(c) Type II, III or IV fluids are normally applied unheated on clean aircraft surfaces for anti-icing, but may be applied heated for deicing, this typically does not take place domestically. This does occur outside of North America.

(d) Type IV fluids (undiluted) have longer freezing precipitation protection times when compared to conventional Type II or III fluids under most weather conditions.

(e) Mixing of different Type II, III or IV fluids from the same or different suppliers in same truck or storage tank is normally not allowed (Contact United Engineering for further information).

NOTE: **Anti-icing fluids do not protect the aircraft surfaces from in-flight icing.**

B. Anti-icing – Protection against Frost, Snow and Ice

(1) Ice, snow or frost will, for a period of time, be prevented from adhering to or accumulating on aircraft surfaces by the application of anti-icing fluids. This section establishes the procedures for the use of anti-icing fluids.

(2) Requirements

(a) Type I / Type IV Critical Surfaces

1 For the purposes of Type I (De-Icing) and Type IV (Anti-Icing) fluid application, the aircraft's critical surfaces are divided into two groups. The first group is Type I Critical Surfaces, the second group is Type IV Critical Surfaces. All critical surfaces of an aircraft need to be clean prior to takeoff. By clean the following is referred; all critical surfaces must be clear of adhering frost, ice, snow or slush with some pre-defined exceptions.

2 The purpose of defining two separate critical surface groups is to identify which critical surfaces of an aircraft do not require Type IV fluid application. Industry experience has shown that Type IV fluid application is not effective and / or required on some critical surfaces of an aircraft.

3 For example, application of Type IV fluid on the vertical stabilizer and rudder of an aircraft is not as effective due to the 90 degree vertical surface angle which allows the fluid to fall to the ground due to gravity shortly after its application, also, this surfaces collect less frost, ice, snow or slush for the same reason. Similar scenario occurs on the aircraft fuselage which has variable surface angles. Industry experience has shown that for Type IV fluid to work effectively, the fluid must remain in the intended surface just prior to takeoff. Industry experience has also shown that applying Type I and following the FAA Hold Over Tables is sufficient to ensure these critical surfaces remain clean.

4 Other critical surfaces such as t»he wings, flaps, slats, ailerons, horizontal stabilizer, and elevators which are directly responsible for the aerodynamic lift of the aircraft collect more frost, ice, snow or slush due to the 180 degree horizontal surface angle. These surfaces do require Type IV fluid application. Application of Type IV on these surfaces are more effective because the applied fluid remains on the surfaces prior to takeoff as intended.

(b) Anti-icing fluid shall be applied to the aircraft surfaces when freezing rain; snow or other freezing precipitation is falling and adhering at the time of aircraft dispatch.

(c) Always apply the same coating to both sides of the aircraft. Both wings and stabilizers must receive the same treatment.

NOTE: **Anti-icing operations with unheated Type II, III or IV fluid must not be initiated if frozen accumulations exist on the aircraft. Perform a visual inspection to determine if contamination exists.**

If accumulations exist, perform a complete deicing operation first before anti-icing with Type II, III or IV fluid.

(d) Once the aircraft has been anti-iced, a deicing operation is required before any repeat anti-icing application.

(3) Recommended Usages

(a) Anti-icing should be carried out as near to departure time as possible in order to utilize available HOT. Anti-icing fluid may be applied to clean aircraft surfaces at the time of arrival on short turnarounds when snow, freezing drizzle or light freezing rain is falling. This will minimize the ice accumulation prior to departure and often makes subsequent deicing unnecessary.

(b) For purposes of overnight protection and / or on receipt of a frost, snow, freezing rain / drizzle or freezing fog warning from local meteorological service, anti-icing fluid may be applied to clean aircraft surfaces prior to the start of freezing precipitation. This will minimize the possibility of snow and ice bonding or reduce the accumulation of frozen precipitation on aircraft surfaces, and facilitate subsequent deicing. Before aircraft departure, check for fluid failure and to ensure fluid has not thickened or gelled. If fluid has not failed, Type II, III and IV Holdover Times apply and process must be documented in Aircraft Deicing / Anti-icing Record. If anti-icing fluid has failed, thickened or gelled remove with heated deicing fluid and reapply anti-icing fluid (as needed).

(4) Spraying Recommendations

(a) For effective anti-icing, an even film of anti-icing fluid is required over the prescribed aircraft surfaces which are clean or which have been deiced. For maximum anti-icing protection, undiluted Type II, III or IV fluid should be used.

(b) The nozzle of the spray gun should be fully open and adjusted to give a full fan pattern.

(c) The anti-icing fluid should be distributed uniformly. In order to control the uniformity, all horizontal and leading edge aircraft surfaces must be visually checked for wetted surface coverage after application.

(d) Fluid just beginning to drop off the leading and trailing edges will visually indicate the sufficient amount required in these areas.

1 Surfaces to be protected are as follows:

a Type IV Critical Surfaces

i. These critical surfaces require Type IV fluid application and respective FAA holdover time guidelines apply.

- Wing Structure
  - Flaps
  - Slats
  - Ailerons
- Tail Control Surfaces
  - Horizontal Stabilizer

- Elevator

(5) Spraying Precautions:

(a) If Type II, III or IV fluids are requested to be applied to the fuselage, use a full fan pattern.

(b) Apply fluid sparingly in a single pass over the top of the fuselage commencing at the most forward cabin entry door location.

(c) If the anti-icing process has been interrupted and the deicing crew is no longer present, the two step process must be repeated.

(d) During a two-step application process (with two distinct fluids), if fluid from the first step (deicing) has been accidentally applied on top of an already treated anti-icing application; the impacted area must be cleaned off with deicing fluid and reapplied with anti-icing fluid.

(6) Areas Forward of the Flight Deck and Flight Deck Windows

(a) When using Type II, III or IV fluids, any forward area from which fluid could flow back onto flight deck windows during taxi or take-off should be free of fluid residue prior to departure. Flight deck windows (especially wiper fitted) should be clear of Type II, III or IV fluid residue.

(b) Do not apply directly to windshields or windscreens.

(c) Do not apply undiluted Type II, III, IV fluids forward of the front cabin door.

7. Aircraft Requirements

A. Engine and APU

(1) If aircraft is exposed to freezing temperatures with any accumulation of water, snow or slush in the engine fan inlets, it is possible for fan blades to freeze to non-rotating parts. If fan will not turn, free up by indirect application of hot deicing fluid at an angle away from engine core inlet, around the periphery. Do not spray fluid into engine core inlet. Hot air may also be used.

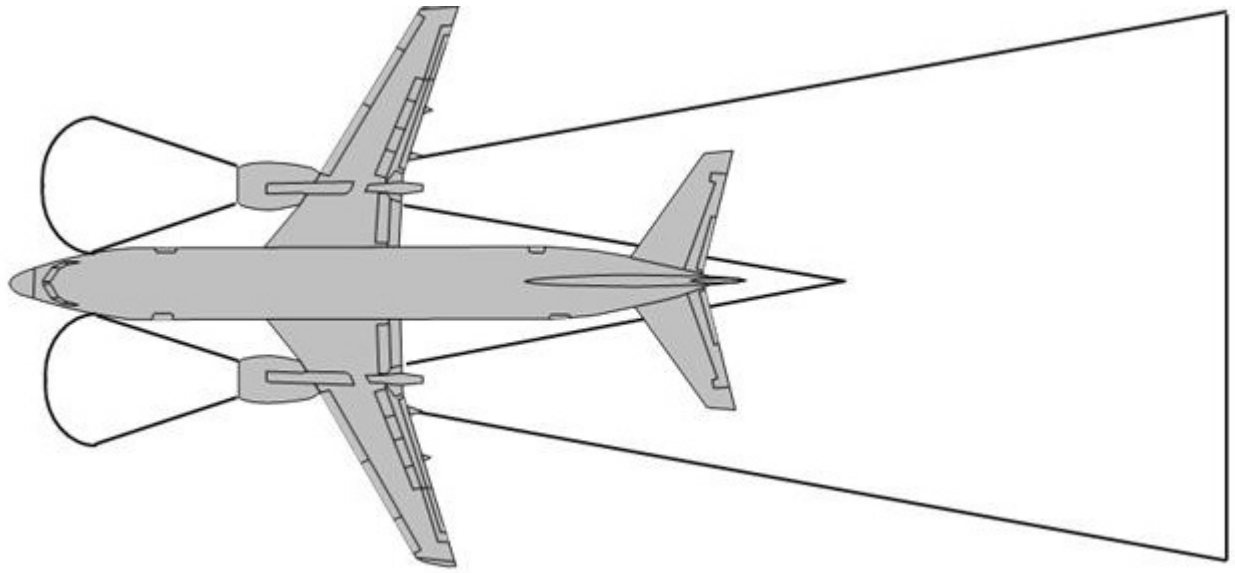
(2) Check for ice build-up on the engine fan blades during cold conditions. Ice normally occurs first on the back (concave) side of the blade. The highest concentrations of ice are typically close to the spinner. Ice at this location can be difficult to detect unless particular attention is directed to the area. If ice is present on the fan blade, remove the ice by applying hot air or hot deicing fluid (sprayed indirectly, at an angle away from engine core inlet; use low flow rate with ground nozzle as applicable). Do not spray fluid into engine core inlet.

(3) Ice may also be removed by directing the fluid spray from the rear of the engine back through the cowling and engine inlet. Care must be used to avoid fluid entering the engine core. A check of the engine inlet including the fan inlet, spinner and guide vanes must be accomplished to verify the process has removed all contaminates.

NOTE 1: **When removing ice / snow from the engine fan inlet, the use of deicing fluid should be kept to the minimum amount required to remove the ice / snow. Prior to engine start excessive accumulation of fluid should be removed from engine fan inlet.**

WARNING: **PERSONS MUST STAY CLEAR OF THE AREAS IN FRONT OF OR IN BACK OF AN ENGINE WHEN THE ENGINE IS OPERATING.**

TYPICAL AIRCRAFT DANGER AREAS



NOTE 2: **Confirm the APU inlet area is clear before starting the APU. The APU can be damaged by ice or snow that has collected if it goes into the inlet. Also, persons must stay clear of the APU exhaust / inlet area when the unit is operating.**

(4) Under normal operating conditions it is recommended that aircraft engines / APU be shut down. For the safety of persons, do not operate the engines or APU during the deicing / anti-icing operations. However, if local procedures require engine / APU operations in order to complete the deicing / anti-icing procedure; the engines will operate at idle speed, do not point the spray of deicing / anti-icing fluids directly into the engine / APU inlets or exhausts or engine thrust reversers and the aircraft is properly configured.

(5) Light snow or frost removal is permitted with APU running. Heavier snow accumulation in the area of the APU inlet will require the APU to be shut down and the inlet door closed prior to washing away snow / slush from the inlet area. Contact flight deck or certified personnel for closing the inlet if required.

B. Miscellaneous Ports and Probes

(1) Do not spray fluid directly at Pitot Inlets, Static Ports, Sensors or Total Air Temperature Probes. Fluids may be sprayed on the skin above the ports and allowed to run down.

C. Cabin and Flight Deck Windows

(1) Do not spray deicing fluid directly on cold cabin or cockpit windows. Spray above if required and allow fluid to run down fuselage. Type IV is prohibited from application on the cockpit and forward of the forward entry.

D. Aircraft Openings

(1) Should operational requirements dictate that passenger and / or cargo doors are open, do not spray in such a manner as to allow fluid to enter the door opening. Do not spray fluid into airplane openings such as scoops, vents, exhaust openings, outflow valves, etc.

E. Flight Control Surfaces

(1) All of the control surfaces must have no ice, snow, or frost adhering to them. Apply deicing / anti-icing fluid for protection.

(2) The deicing operator will visually ensure ice or snow is not forced into areas around flight control hinge, mechanisms and leading edge devices.

NOTE: **Under Wing Contamination Upon Arrival**

(3) On occasion Flight Operations may not retract flaps and slats upon arrival. This is due to contamination found on the arrival runway or taxiways. Retracting these with contamination may result in contamination being introduced into areas where it could melt, refreeze and damage the structure. During these events, Flight Operations will contact Station Operations (or Maintenance if severe) to coordinate the removal of contamination and retraction of the flaps and slats. When contamination is being removed from these areas, there is no requirement to verify the aircraft is configured for deicing. This, however is the only area that may be deiced. If other areas are required to be deiced the aircraft must be verified configured. Once the contamination has been removed, notify Station Operations (Flight Operations or Maintenance as applicable).

(4) If trailing edges are extended for accomplishment of the leading edge device check, the certified deicer will visually check the slats, flap tracks and flaps for presence of packed snow or slush and remove as necessary.

(5) Follow normal deicing procedures for removal of contamination.

(6) Upon completion notify trained and certified personnel to retract the slats / flaps.

NOTE 1: **Flight control surfaces should only be operated by trained and certified individuals.**

NOTE 2: **B737 only – The horizontal Stabilizer must be level or a range to full nose down before the deicing operation. (Leading edge level through up)**

NOTE 3: **Where a minimal amount of fluid will be used to remove frost from the B737, movement of the stabilizer is not required.**

NOTE 4: **B737-700/-800/-900/-900ER/-NG/MAX Cold Soaked Fuel Frost –Takeoff with cold soaked fuel frost on the wing tank upper surfaces is allowed if both Deicing Crew and Flight Deck are in agreement with the condition of the aircraft and none of the following conditions are present:**

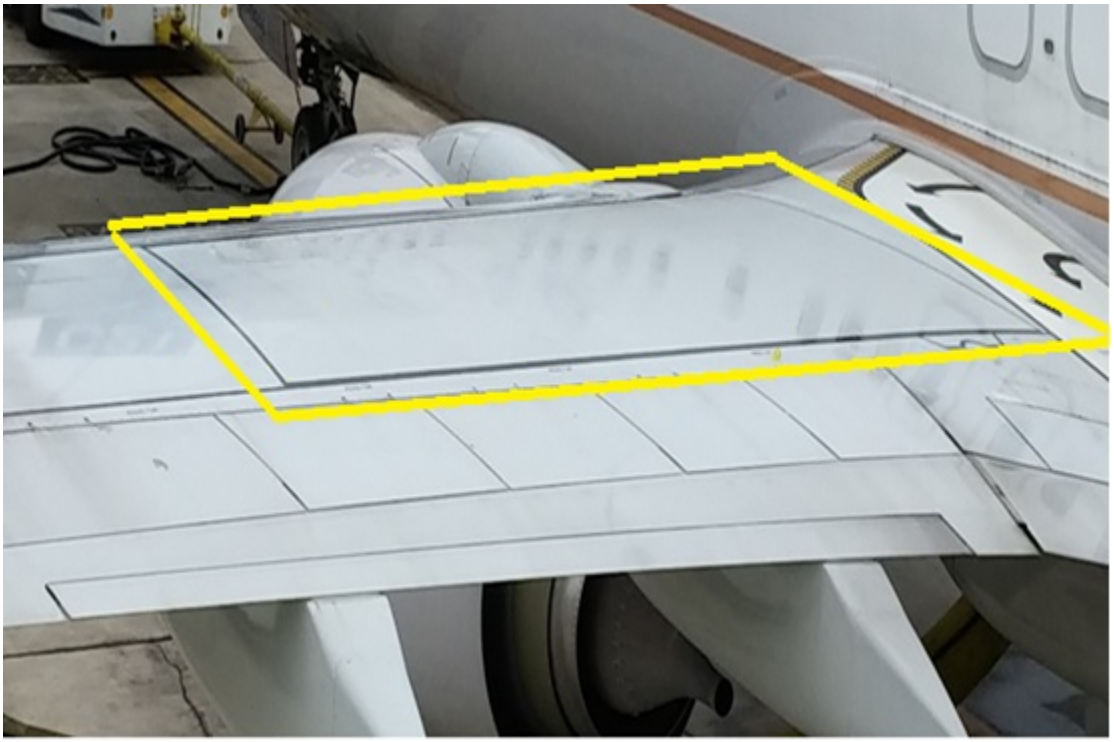
(a) **The ambient temperature is Below +4 °C (+39°F)**

(b) **The tank fuel temperature is below -16°C (+3°F)**

(c) **There is cold soaked fuel frost on the wing tank upper surfaces that is beyond the lines defining the permissible cold soaked fuel frost area.**

(d) **There is precipitation or visible moisture (rain, snow, drizzle or fog with less than 1 mile visibility).**

"BLACK BOX"

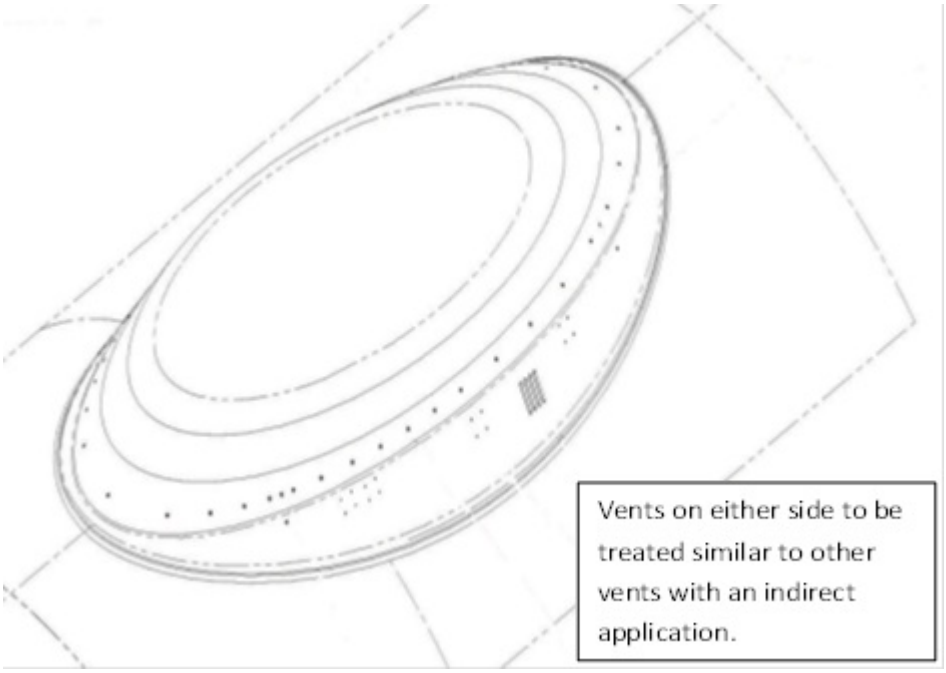


NOTE 5: **A319/320 only – Apply minimal deicing fluid in the rudder, elevator and aileron servo-control areas. Use sufficient fluid to remove snow.**

NOTE 6: **The 787 is primarily built from composite materials. Current data indicates Type I HOT on composite materials may have a 30% reduction in holdover time. Therefore, pay special attention to the time frame at which the Type I and Type IV application takes place.**

NOTE 7: **Multiple fleets are being modified with the LIVETV Ka Connectivity System. The system is mounted on top of the fuselage and appears as a dome. On either side is a vent requiring an indirect application.**

LIVETV CONNECTIVITY SYSTEM

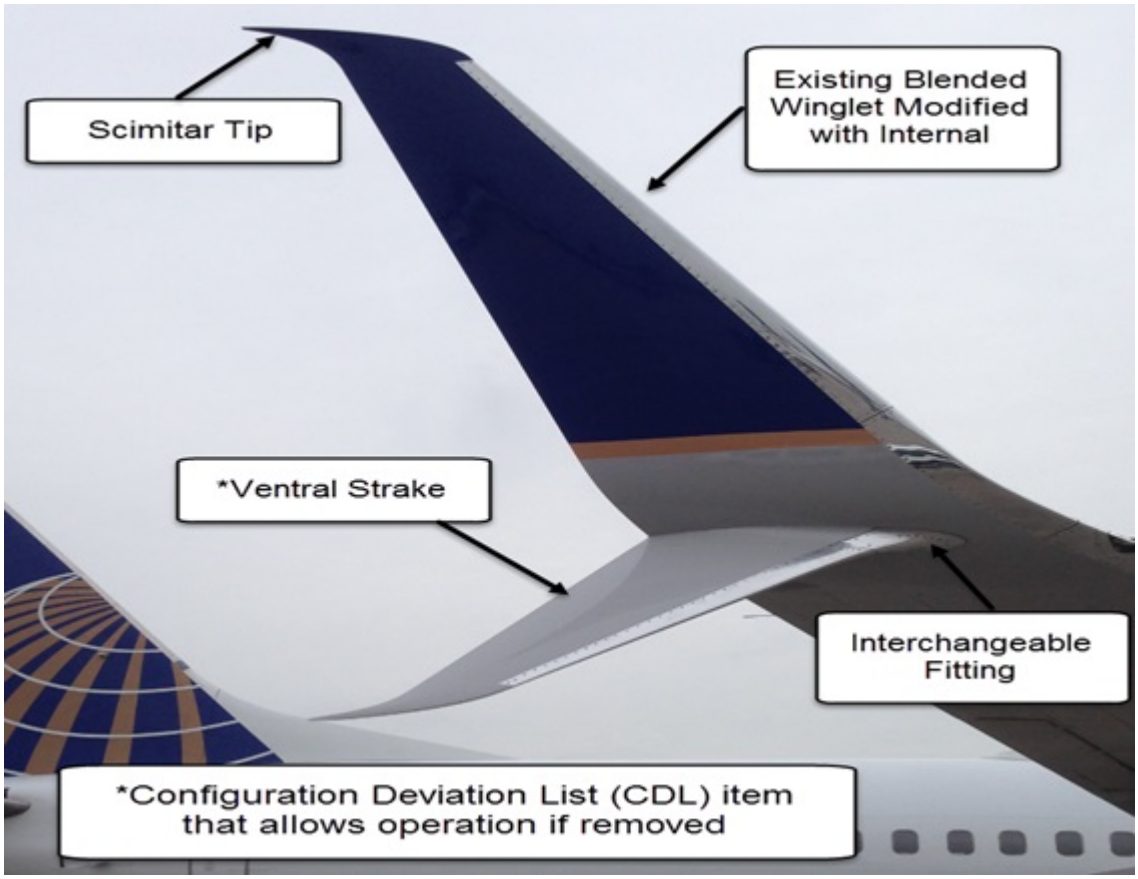


(7) Winglets are present on many fleet types. They range in size up to nine feet and constructed of composite materials. Spray at an angle of 45º or less and a lower fluid flow rate.

NOTE: **The Ventral Strake (lower portion of the Split Scimitar Wingtip) will require all surfaces to be clean of contamination (deiced) as applicable.**

(8) During period of falling freezing precipitation, deice the entire wing tip as applicable removing contamination from the lower portion as needed.

VENTRAL STRAKE WINGLET



NOTE: **Use extreme caution when deicing / anti-icing aircraft with winglets.**

(9) Pay special attention to the height clearance of the winglets when deicing / anti-icing from the horizontal stabilizer or vertical stabilizer.

F. Wing Fuel Tanks

(1) Frost can occur on the bottom of the wings in the fuel tank areas in temperatures above freezing. This is caused by the condensation of moisture in the air when it touches cold surfaces that are below freezing. The frost will usually melt when fuel is added that is at a higher temperature. If the frost continues and is more than 1/8 inch (3 mm) thick, remove it before the takeoff.

(2) Clear ice can occur on the top of the wing when these conditions occur:

(a) The temperature of the fuel in the tank is below freezing.

(b) The ambient temperature is above freezing.

(c) There is rain, drizzle or fog.

G. Landing Gear and Landing Gear Doors

(1) Visually verify there is not a layer of ice and / or snow on the movable parts and the position indication switches for the landing gear. This could prevent the correct operation of

the landing gear. Verify you do not remove lubricants or make the lubricants thinner when you apply de-icing / anti-icing fluids. Parts that are not lubricated can cease or not operate without the correct servicing.

(2) Remove the ice and snow from all areas of the landing gear and gear doors.

(3) Examine the alternate extend system for ice that has collected in these areas that are open and not heated:

(a) Examine control cables for Landing gear extension

(b) Examine the external mechanism for the Landing gear

(4) Confirm that ice did not collect on the steering cables for the nose wheel. Remove the ice as required.

H. Brakes

(1) When deicing or anti-icing the airplane, protect the wheels and brakes from fluid contamination with the methods below:

(a) Do not direct a spray of deicing fluids at the wheels or brakes.

(b) The brakes must be cool (you can put your hand near the housing) before you apply deicing fluid to the wheel area.

(c) Use a small quantity of fluid to keep it out of the wheel bearings and heat sinks.

(d) Apply fluid from directly in front or behind the assembly to avoid deflecting contaminates into the brake area.

8. Pilot Information

A. Pilot Notification

(1) If the Pilot is onboard, certified ground personnel will advise that deicing is about to begin by one of the following methods: in person, via the intercom system of the aircraft, local signage or by VHF communication from operations / ramp control or deicing unit / deicing coordinator.

(2) Before the ground crew deices the aircraft, a positive response is required from the Pilot (flight deck or certified personnel) that the aircraft configuration is ready for deicing.

(3) The Pilot is to be advised when deicing operation has been completed and aircraft systems can be returned to normal operation.

NOTE: **When using VHF (ground to air) communications, always identify the aircraft by flight number.**

B. Pilot Communication

(1) During periods of freezing precipitation, certified deicing personnel will be responsible for notifying the Pilot via the headset of the aircraft or by VHF communications that the aircraft was deiced / anti-iced using the communication format described below.

(2) This information will allow the Pilot to determine expected HOT under prevailing weather conditions.

(3) The following format is based on international standard (AS 6285) and should be utilized no matter whom performs the deicing / anti-icing operation:

(a) Element A: Specify "Type" I for Type I fluid, "Type" II for Type II fluid, "Type" III for Type III fluid or "Type" IV for Type IV fluid. If Type II, III and IV, specify full product name (manufacturer and brand) used e.g. Kilfrost ABC-S plus.

(b) Element B: Specify the percentage of fluid within the fluid / water mixture (e.g. 100 = 100% fluid, 0% water and 75 = 75% fluid, 25% water).

NOTE: **Report the concentration of Type II, III and IV fluid / water mixtures by volume. Reporting the concentration of Type I fluid is not required.**

(c) Element C: Specify the local time (hour and minutes) of the beginning of the final deicing / anti-icing step (e.g. 1330).

(d) Element D: Specify date.

NOTE: **The date is not required at United during crew communication but is required for the documentation of deicing / anti-icing operations.**

(e) Element E: “Post Application Check Complete”. Confirms to the Flight Deck that Post Deicing / Anti-icing Checks are complete, all critical aircraft surfaces are free of frozen contaminants and associated deicing equipment is clear of aircraft.

1 Example 1: Type I – 1100 Post Application Check Complete

Explanation – deiced with Type I fluid with last step beginning at 1100 and the post application check for cleanliness of critical aircraft surfaces is complete, surfaces are clean and equipment is clear of the aircraft.

2 Example 2: Type IV Kilfrost ABC-S Plus – 100% – 1015 Post Application Check Complete.

Explanation – aircraft anti-iced with undiluted Kilfrost ABC-S plus Type IV fluid with last step beginning at 1015 and the post application check for cleanliness of critical aircraft surfaces is complete, surfaces are clean and equipment is clear of the aircraft.

NOTE 1: **No flight crew communication is required and no HOT applies if the aircraft is deiced for overnight frost in the absence of further precipitation or self-generating frost. However, a record of overnight frost removal is required.**

NOTE 2: **Reporting the product name of Type IV fluid allows the pilot to use product specific Holdover Guidelines, which give the maximum holdover times.**

9. Ground Crew Deicing Checks

A. Post Deicing Check

(1) Aircraft surfaces must be checked as part of the deicing / anti-icing operation and shall be visibly "clean" as follows: clear of frost, ice, snow and slush. The following elements must be checked:

(a) Wings and winglets – Shall be free of ice, slush, snow, or frost. Some coating of frost may be permissible on wing tank lower surfaces cold-soaked by fuel

(b) Tail – Shall be free of ice, slush, snow, or frost.

(c) Flight control surfaces: Some coating of frost may be permissible on wing tank lower surfaces cold-soaked by fuel.

(d) Flight control – Functional check: Aircraft subjected to an extreme ice or snow covering require a functional flight control check

(e) Pitot Tubes, Static ports, Air stream direction detector probes and angle of attack sensors.

(f) Engine inlets: Clear of internal ice, snow, and slush and fan free to rotate.

(g) Air conditioning inlets / exits and Outflow valves: clear and unobstructed.

(h) Landing gear and landing gear doors: Unobstructed and clear of frost, ice, snow and slush.

(i) Fuel Tank vents: Clear of frost, ice, snow and slush.

(j) Fuselage / Nose: Clear of ice, snow and slush to reduce aircraft weight and aerodynamic drag.

(k) Doors: Do not close any door until all ice, snow and slush have been removed from the surrounding area.

WARNING: **FAILURE TO ENSURE THE AIRCRAFT IS FREE OF CONTAMINATION WILL RESULT IN DECREASE OF LIFT, INCREASE IN DRAG AND REDUCES AIRCRAFT STABILITY.**

B. The driver and sprayer will work in tandem to confirm the contamination status of the aircraft during the process. This means the driver and sprayer will not advance the truck to another section of the aircraft until the sprayer has given indication the area being worked is free of contamination.

(1) The areas listed below must be free of contamination:

(a) Wings and Winglets

(b) Tail

(c) Flight Control Surfaces

(d) Ports and heads

(e) APU inlets / exhausts (as applicable)

(f) Fuselage (light hoar frost on crown is allowed, lettering or riveting patterns can be seen through the frost)

(g) Nose

(h) Engine inlets

(i) Landing gear and landing gear doors

(j) Vents and doors

WARNING: **FAILURE TO ENSURE THE AIRCRAFT IS FREE OF CONTAMINATION WILL RESULT IN DECREASE OF LIFT, INCREASE IN DRAG AND REDUCES AIRCRAFT STABILITY.**

(2) Once the deicing crew has determined the aircraft clean of contamination, the post application communication may be given to the flight deck.

NOTE: **When multiple trucks are used to deice an aircraft, one truck will be assigned as the lead truck and have the additional responsibility of ensuring all other trucks working the individual flight have completed the above validation prior to the post application communication to the flight deck. This function may also be completed by independent personnel provided the same process is followed. Station operations that include the use of deicing vehicles with single person drive systems will incorporate the use of other trained and certified personnel (Crew chief, Lead, OPC, etc.) outside of the aircraft cabin to verify the results of the post deicing check.**

FLIGHT OPERATIONS

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FLIGHT OPERATIONS

FLIGHT OPERATIONS

GENERAL

- Reference Flight Operations Manual (FOM) Chapter 7 Section 30 “Deicing/Anti-Icing”.

SNOWFLAKE

1. INTRODUCTION

   A. This manual is a reference for United Snowflake Operations. This document contains information which is intended to outline procedures utilized by qualified Snowflake personnel (referred to as Snowflake Operators here after) during the periods that a declaration of Winter Operations Plan has been implemented.

   B. A Winter Operations Snowflake Coordinator will be identified where Snowflake Operations are applicable. Normally, the respective base Chief Pilot will occupy the position of Snowflake Coordinator but retains the authority to temporarily delegate those duties to an individual within his or her department. The Snowflake Coordinator is responsible for adherence to this manual in regards to Snowflake Operations.

   C. In an attempt to define the role of the Aircraft Inspection Vehicle call sign “Snowflake”, it should be stated that any level of requested intervention or inspection completed by Snowflake Operators at no time supersedes Pilot in Command Authority. The information provided by Snowflake Operators, who are specifically trained pilot(s) on location, is designed to help both Flight Operations and Airport Operations navigate the complexities of a Winter Operations Program during periods of inclement weather. All information provided by Snowflake Operators is to be considered “informational only” and done at the request of the pilots or Airport Operations staff. Operating pilots retain the responsibility to conduct a Wing Check when the aircraft has not commenced takeoff roll within the holdover time, or, when a Nose Check determines the initial holdover time is no longer valid due to changing conditions or observation of contaminates on representative surfaces.

   D. Snowflake Operators shall be considered an additional resource made available to the pilots for the purposes of ascertaining Winter Operations information and for aiding in determining the requirement for adherence to the “clean” aircraft concept.

   E. If, under any circumstances, the operating pilots cannot ascertain that the aircraft is clean, takeoff is prohibited.

2. SNOWFLAKE MANUAL REVISION PROCESS

   A. Flight Operations, in coordination with Airport Operations, will update the United Deice and Anti-Ice Program and revise the Snowflake Manual.

3. UNITED JEPPESEN 10-7 PAGE WINTER OPERATIONS PROCEDURES AND REVISIONS

   A. The Chief Pilot shall assist in identifying winter operations policy and procedural revisions concerning the United Jeppesen 10-7 page (s) to Flight Operations. Flight Operations will coordinate the revision with Jeppesen and Airport Operations.

4. DEFINITIONS AND TERMINOLOGY

   A. Snowflake Operators may find detailed information clarifying cold weather / winter operations in the Flight Operations Manual, Adverse Weather Chapter.

5. SECTION 1 – SNOWFLAKE VEHICLE

   A. **SECTION 1: Part 1 – Type Vehicle**

(1) A vehicle capable of maneuvering in poor surface conditions and / or low visibility shall be designated by the Snowflake Coordinator and made available for the period October 1 thru April 31.

(2) A designated location will be identified on the airfield for the purposes of parking the vehicle when not being utilized in the operation. The designated airfield parking location facilitates the re-fueling process and allows the Snowflake Operators to access the vehicle. The Snowflake Coordinator will ensure all qualified Snowflake Operators are provided with the necessary vehicle keys prior to October 1.

B. **SECTION 1: Part 2 – External Markings**

(1) The Snowflake vehicle shall be equipped with external markings identifying it as an Aircraft Inspection Vehicle (see photo below). These markings will include the Snowflake Vehicle contact frequency and shall be large enough to be readily identifiable by the pilots in periods of reduced visibility.

(2) The Snowflake vehicle will be equipped with a light bar and / or strobe lights in compliance with local airport authority ground vehicle operator regulations. The exterior vehicle lighting must meet local regulations, but also serve as an aid to better identify the Snowflake vehicle in periods of reduced visibility by pilots, other ground vehicles, (i.e. snow removal equipment) and the various controlling agencies (i.e. FAA Air Traffic Control Tower, Ramp Control, etc.).

FIGURE 01 - SNOWFLAKE VEHICLE EXTERNAL MARKINGS

C. **SECTION 1: Part 3 – Equipment Installed**

(1) The following list of required equipment will be installed and properly maintained in the Snowflake Vehicle during the period October 1 thru April 31:

(a) A minimum of two radios capable of maintaining constant two-way communication with both ground based facilities and / or aircraft.

(b) Spot-like type external lighting capable of illuminating the critical surfaces of the aircraft. The spot-like type lighting devices pictured below are designed with the ability to rotate three-hundred sixty degrees and tilt vertically approximately ninety degrees. These remote controlled lights may be used by the Snowflake Operator to illuminate the aircraft's critical surfaces.

FIGURE 02 - SNOWFLAKE VEHICLE SPOT-LIGHT LIGHTING

(c) A back-up hand held illumination device capable of illuminating the aircrafts critical surfaces in the event of vehicle based lighting failure. This back-up device is only required and applicable to night operations. A household 2D Cell Battery Flashlight or equivalent will meet this requirement.

(2) The Snowflake Vehicle may be equipped with a laptop / iPad with internet capability to assist the Snowflake Operator(s) in the performance of their duties. When equipped, the Snowflake Operator(s) will use the laptop / iPad for the primary purpose of accessing real-time and forecasted weather conditions and Holdover Times. The ability to view Doppler radar computer generated graphics significantly enhances the Snowflake Operator(s) ability to interpret current weather conditions as well as predict short-term weather pattern types and intensities. This information is especially helpful in regions of the country where weather patterns have the ability to change rapidly (i.e. lake effect conditions).

(3) This information may then be communicated to the pilots at their request in an effort to assist them with their Precipitation Intensity Procedures detailed in the Flight Operations Manual, Adverse Weather Chapter.

D. **SECTION 1: Part 4 – Vehicle Preventive Maintenance**

(1) It is the responsibility of the Snowflake Coordinator to ensure the Aircraft Inspection Vehicle is maintained in compliance with United Ground Vehicle inspection standards.

(2) A record of all routine maintenance will be documented and maintained within the vehicle.

(3) Attention shall be paid to vehicle headlights, taillights, directional signals, window wipers and defogging systems. If any inoperative component would render the vehicle unsafe for operation, that component will be replaced and / or repaired prior to entry onto the airfield.

E. **SECTION 1: Part 5 – Safety Equipment**

(1) The vehicle will maintain a Safety Kit which includes the following safety items:

(a) A flashlight (A household 2D Cell Battery Flashlight or equivalent will meet this requirement)

(b) A minimum number of safety vests to accommodate onboard operators.

(c) Hearing protection

F. **SECTION 1: Part 6 – Radio Frequencies Monitored**

(1) During periods when the Aircraft Inspection Vehicle is in a location that requires direct communication with ATC, it is the responsibility of the Snowflake Operator(s) to be in direct communication with the local Air Traffic Control and Ramp Control (as applicable) facilities.

(2) Operators should use the following radio configuration:

(a) Dedicate one radio for communication with respect to vehicle movement.

1 Prior to operating the vehicle on the Terminal Ramp, contact Ramp Control where appropriate and then transition to ATC Ground / Tower Control when operating on or transitioning to active taxiways and / or runways.

(b) The second radio should be dedicated to coordination between the aircraft(s) and the Snowflake vehicle.

6. SECTION 2 – SNOWFLAKE PERSONNEL

A. **SECTION 2: Part 1 – Certification and Qualifications**

(1) Local Airport Requirements:

(a) All Snowflake Operators are required to be current and qualified SIDA badged employees. These employees must have completed the necessary training and certification process to drive a vehicle within both non-movement and movement areas (as applicable) on the airfield in accordance with United vehicle operator regulations and local Airport Authority regulations. Specific vehicular operator regulations may vary with location and ultimately governed by the local Airport Authority.

1 All Snowflake Vehicle Operators are required to complete Driver Training Programs in accordance with Local Airport Authority regulations.

B. **Flight Operations Snowflake (Supplemental)**

(1) Annual Training (ULN Course Code R20S) "Base Specific Snowflake Training"

(a) The requirements of this course will be designated and facilitated by Flight Operations. The training must be assigned, if the training does not appear in your learning plan please contact your Chief Pilot.

(b) Curriculum Includes:

1 Winter Operations Rules and Regulations

2 Fluid Identification

3 Snowflake Procedural Guidance

(c) Requires successful completion of the TOL e-learning lesson and assessment.

(2) The base Chief Pilot or his designee is responsible to ensure all Snowflake Operators have completed the required training.

(3) Local Snowflake Requirements:

(a) The Snowflake Coordinator is responsible for the selection, training and currency of all Snowflake Operators within his or her specific base.

(4) Snowflake Operators are required to be intimately familiar with:

(a) Deice / anti-ice procedures specific to their geographical location.

(b) Procedures contained within the United Flight Operations Manual, Adverse Weather Chapter.

C. **SECTION 2: Part 2 – Scheduling of Snowflake Personnel**

(1) The Snowflake Coordinator will identify shift(s) on the days when conditions warrant.

D. **SECTION 2: Part 3 – Vehicle Staffing Requirements**

(1) Two operators may be staffed in the vehicle while operating at night or in significantly reduced visibility. This requirement tasks the safe operation of the vehicle to one operator and allows the second operator to concentrate on conducting weather precipitation and intensity assessments, Laptop / iPad tasks, and verbal coordination and communication with aircraft, ATC, Ramp Operations, or Airport Operations. Dependent on weather conditions during daylight hours and with the approval of the Snowflake Coordinator it is permissible to staff the Snowflake vehicle with one Operator.

7. **SECTION 3 – AREA OF OPERATIONS**

A. The Aircraft Inspection Vehicle will be in appropriate locations on the airport to provide information as necessary and requested by pilots concerning the external condition of aircraft in respect to winter operations and winter conditions.

B. **SECTION 3: Part 1 – EWR Base Specific**

(1) Newark Liberty International Airport to include but not necessarily limited to the Airport Operations Area (AOA), and all access roads facilitating the Snowflake Vehicle's movement on the airfield to conduct inspections.

(2) The Snowflake Vehicle will be in position as a resource for pilots and Airport Operations. Snowflake will operate on the Snowflake frequency 129.37. During periods when local weather conditions are such that frozen precipitation (i.e. ice, snow, slush, frost, or freezing rain) can be reasonably expected to adhere to and / or accumulate on the airplane or as determined by the Snowflake Coordinator.

C. **SECTION 3: Part 2 – IAH Base Specific**

(1) Houston George Bush Intercontinental Airport to include but not necessarily limited to the Airport Operations Area (AOA), and all access roads facilitating the Snowflake Vehicle's movement on the airfield to conduct inspections.

(2) The Snowflake Vehicle will be in position to provide informational condition of the aircraft. Snowflake will operate on the Snowflake frequency 129.92. During periods when local weather conditions are such that frozen precipitation (i.e. ice, snow, slush, frost, or freezing rain) can be reasonably expected to adhere to and / or accumulate on the airplane or as determined by the Snowflake Coordinator.

D. **SECTION 3: Part 3 – ORD Base Specific**

(1) Chicago O'Hare Intercontinental Airport to include but not necessarily limited to the Airport Operations Area (AOA), and all access roads facilitating the Snowflake Vehicle's movement on the airfield to conduct inspections.

(2) The Snowflake Vehicle will be in position to provide informational condition of the aircraft. Snowflake will operate on the Snowflake frequency 129.57. During periods when local weather conditions are such that frozen precipitation (i.e. ice, snow, slush, frost, or freezing rain) can be reasonably expected to adhere to and / or accumulate on the airplane or as determined by the Snowflake Coordinator, the Snowflake Vehicle may be in position at the following locations: Terminal Ramp, Deice Facility.

E. **SECTION 3: Part 4 – DEN Base Specific**

(1) Denver International Airport to include but not necessarily limited to the Airport Operations Area (AOA), deicing facilities, and all access roads facilitating the Snowflake Vehicle's movement on the airfield to conduct inspections.

(2) The Snowflake Vehicle will be in position to provide informational condition of the aircraft. Snowflake will operate on the Snowflake frequency 130.22. During periods when local weather conditions are such that frozen precipitation (i.e. ice, snow, slush, frost, or freezing rain) can be reasonably expected to adhere to and / or accumulate on the airplane or as determined by the Snowflake Coordinator, the Snowflake Vehicle may be in position at the following locations: Terminal Ramp, Deice Facility.

F. **SECTION 3: Part 5 – IAD Base Specific**

(1) Washington Dulles Intercontinental Airport to include but not necessarily limited to the Airport Operations Area (AOA), and all access roads facilitating the Snowflake Vehicle's movement on the airfield to conduct inspections.

(2) The Snowflake Vehicle will be in position to provide informational condition of the aircraft. Snowflake will operate on the Snowflake frequency 128.97. During periods when local weather conditions are such that frozen precipitation (i.e. ice, snow, slush, frost, or freezing rain) can be reasonably expected to adhere to and / or accumulate on the airplane or as determined by the Snowflake Coordinator, the Snowflake Vehicle may be in position at the following locations: Terminal Ramp, Deice Facility.

G. **SECTION 3: Part 7 – Activation of Snowflake Operations**

(1) Snowflake Operations will be implemented as determined by the Snowflake Coordinator.

(2) **Step 1** Coordination of Winter Operations Plan

(a) The Snowflake Coordinator for each base is responsible to establish a communication plan between United Airport Operations and the Snowflake Coordinator.

(b) During periods when winter precipitation is forecasted, a communication plan that assures immediate contact capability is required (cell phone).

(c) Prior to periods when winter precipitation is forecasted, the Snowflake Coordinator will personally contact the scheduled Snowflake Operator(s) in advance and notify them of required report time and location.

(3) **Step 2** Inspection of Snowflake Vehicle:

(a) Prior to periods when winter precipitation is forecasted, the Snowflake Operator(s) will inspect the vehicle and operate vehicle components as necessary to ensure proper component operation and fluid levels (e.g.. fuel, head lights, light bar, strobes, external inspection lighting).

(b) The operator will conduct a check of all required radio equipment.

(c) The operator will ensure the Safety Kit with the above mentioned equipment (see section 1 part 5) is located within the vehicle and accessible.

(d) At the completion of the Safety Kit Check a notation will be made in the vehicle maintenance log.

(4) **Step 3**

(a) A notification of Snowflake's intent to operate must be communicated to the following agencies (as station specific procedures dictate) prior to activation:

1 Notification to local airport authority (if required) by local regulations.

2 Notification to the local air traffic control facility (if required) of intent to operate on the field and anticipated location.

3 Notification to the local United Airport Operations Center of time and anticipated location of vehicle on the airfield.

(5) **Step 4**

(a) Notification to the Pilots.

(b) Pilots will be notified of the activation of Snowflake Operations using the following:

1 Notification by United Airport Operations displayed on the Ramp Information Displays (RID).

2 Broadcast transmissions on location specific Ramp Control Frequencies.

a Bulletins in the FPA / CPO locations on site

b Station specific Ops Alerts

3 Pilots may at any time contact local United Operations via the United Ops frequency for verification of Snowflake Operations status.

(6) **Step 5 (if applicable)**

(a) Coordination and positioning of the Snowflake Vehicle at designated observation locations depends on departing runway configuration.

H. **SECTION 3: Part 8 – Suspension of Snowflake Operations**

(1) At the time the Snowflake Operator, in conjunction with the United Airport Operations Coordinator, determine that winter operations is no longer in effect, the Snowflake Operator will notify the following agencies that Snowflake Operations will be suspended:

(a) Local City Operations (if required) that the Snowflake vehicle is suspending operations and no longer operating on the airfield.

(b) Air Traffic Control (if required) of their intent to depart the airfield and suspend Snowflake Operations.

(c) United Operations will declare the intent to suspend Snowflake Operations.

(d) The Snowflake Operator(s) will notify the Snowflake Coordinator that Snowflake Operations have been suspended.

8. **SECTION 4 – SNOWFLAKE BEST PRACTICES**

A. Any irregular operations event will likely have a successful outcome and minimized schedule disruption if the following is adhered to with regards to Planning, Execution, and Recovery.

B. **Planning**

(1) Winter storms are generally forecast days in advance, allowing for significant opportunity to prepare. For that reason, the Snowflake Coordinator is encouraged to attend all meetings, both local and network level, to establish a local operations plan with focus on the following items:

(a) Start, duration, and end of significant weather.

(b) Weather type, intensity, and periods of change. The type and intensity of the precipitation is a key determining factor in Holdover Times.

(c) Special, non-normal procedures planned to be used at the network or local level. These may include delay programs or additional deicing / anti-icing locations.

(2) The NOC is a resource that may be utilized through all phases of the winter storm to obtain information that can aid in execution. Additionally, a WSI representative is available to discuss weather outlook and can be contacted through the NOC.

(3) If possible, it is suggested to notify Airport Operations, local authorities and Pilots of the plan to operate Snowflake in advance of the significant weather event. Individual station procedures may be used to properly communicate Snowflake plans.

C. **Execution**

(1) Snowflake Operators should be prepared to be a knowledgeable resource that Pilots, AO, and ATC can utilize to gain operational information. Snowflake Operators and Coordinators should understand that information sharing and communication to pilots has a larger impact on the operation. Snowflake Operators should prioritize information sharing rather than spending time waiting for pilots to request aircraft inspections.

(2) Once the Snowflake Operators have familiarized themselves with the information detailed in the 'Planning' stage, they should plan on doing the following as soon as practical during significant weather events:

(a) Utilize SSD and Airport Operations to determine which flights need immediate Snowflake intervention. Snowflake can intervene on flights which are still at the gate or have already pushed back.

1 Training on how to utilize SSD effectively is included in the annual training program.

(b) If no immediate intervention is required, utilize SSD and Airport Operations to determine the next departures and prioritize them based on location, type of operation, and CCO times, among many other factors. Snowflake Operators are integral in sharing any pre-flight steps (overnight pre-treating) with pilots.

1 Snowflake Operators should note that long-haul international flights tend to be higher profile and have pilots that are less familiar with Winter Operations. Extra time should be spent monitoring these flights.

2 Pilots greatly value the time and information that a Snowflake Operator shares when visits to the flight deck are made prior to departure. Approaching pilots before departure is a preferred method of information sharing.

a Snowflake Operators should be prepared for questions pertaining to deice pad wait times, taxi times, forecast weather, and HOT / Allowance Times.

(c) If the above has been completed, make yourself known to pilots, AO, ATC, TOMC and Deice Service Providers at the CPO/FPA, in the Snowflake Vehicle, or in Station Ops. Be prepared to answer operational, procedural and weather-related questions.

(3) Snowflake Operators are expected to maintain awareness of remaining departures, current HOTs, current deicing / anti-icing times, taxi times, and departure rates. Snowflake Operators have a unique understanding of the multiple tasks that need to be safely and methodically accomplished on the flight deck and are encouraged to assist in advocating those needs to facilitate a successful operation.

D. **Recovery / Shutdown**

(1) Snowflake Operators should ensure that they are prepared for the next day's operation at the conclusion of the day's significant weather event. The following tasks should be completed:

(a) Completing or submitting requested reports to the Snowflake Coordinator

(b) Servicing / securing the Snowflake Vehicle

(c) Providing notification to requested entities / departments of your intent to suspend operations

(2) If a multi-day event is expected, brief subsequent operators on the plans for the next day, including any special STAR procedures or overnight items.

E. **Aircraft Inspection – Flaps**

(1) Per the Flight Operational Manual, pilots are to leave the flaps down if there is suspected contamination. Pilots are to notify the SOC and Station Operations, if flaps have been left down. Snowflake Operators can provide the groups identified above with a report of the flap condition to determine whether contamination is present or if deicing / anti-icing is required.

(2) Snowflake Operators should conduct and inspection of the flap assembly and look for any ice accumulation.

(a) In the event that no contaminants are found, Snowflake can aid in the retraction of the flaps with coordination of the SOC, Station Operations, TOMC or Maintenance. Contact the SOC, Station Operations, TOMC or Maintenance prior to bringing the flaps up. Flap movement should be coordinated with ground staff to ensure that the area surrounding the flaps is clear.

(b) In the event that contaminants are found, Snowflake should notify the applicable parties so that deicing / anti-icing can be accomplished. Coordinate the deice / anti-ice procedure with the SOC, Station Operations, TOMC or Maintenance. Operator(s) can aid in flap retraction once the aircraft has been certified clean.

F. **Aircraft Inspection – Body**

(1) In the event that a crew asks you to provide an inspection of the aircraft, the following guidance will be used by Snowflake Operators when conducting an inspection.

(2) If possible position the vehicle perpendicular or at least angled to the aircraft's taxi direction. This technique aids the pilots in recognition of the Snowflake vehicle and it's location in poor visibility conditions.

(3) Once the aircraft has come to a complete stop, prior to movement of the vehicle the snowflake operator will confirm with the pilots that the aircraft parking brake has been set and the engine thrust levers are at idle. The aircraft configuration will be determined by the pilots based on surface conditions and guidance provided in the Aircraft Flight Manual. If takeoff is imminent the pilots may be requested by Snowflake personnel to configure for departure to aid in the inspection process.

(4) During periods of reduced visibility and / or night conditions the pilots should be requested to turn on exterior lighting including wing and tail lighting (if equipped).

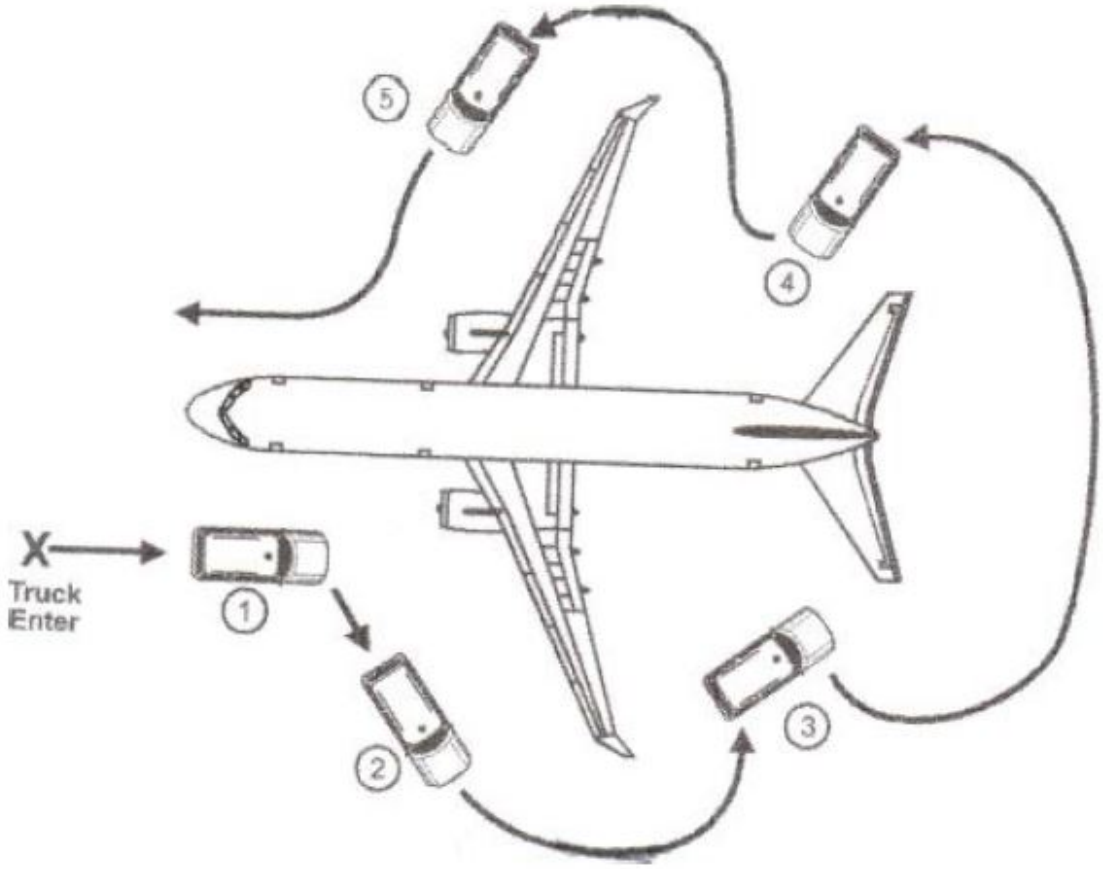
(5) Only after the Snowflake Operator has received verbal confirmation of the required aircraft configuration is it safe to "approach the aircraft" and initiate the visual inspection process. It may also be prudent to advise the pilots to note the time for the purposes of ensuring adherence to the 5-minute requirement.

NOTE: **When qualified United Snowflake personnel, trained in winter operations are present, inputs from these personnel concerning aircraft condition relating to effects of precipitation may be considered by the captain to determine deice / anti-ice requirements for takeoff. Pilots should understand that when a Wing Check is required, the pilots assigned to the flight must accomplish the required duties, the availability of Snowflake does not relieve them of Wing Check responsibilities as defined in the Flight Operations Manual, Adverse Weather.**

(6) Depending on the aircraft's position, inspection location and surface field conditions (i.e. snow piles, accumulation as a result of drifting and / or plowing, etc.) it is preferable for the Snowflake vehicle to approach the aircraft from the front and aircraft left. This technique

allows the Captain to visually confirm that the Snowflake vehicle has initiated its inspection. The vehicle then can proceed around the aircraft in a counter clockwise fashion observing critical surfaces (see diagram below). The counter clockwise approach also allows the Snowflake Driver a constant sight picture of the aircraft as the vehicle continues around the aircraft. The driver should concentrate on maneuvering the vehicle while the second Snowflake Operator or Observer can concentrate on conducting a thorough inspection of the aircraft's critical surfaces. The Snowflake Observer shall pay particular attention to the critical aircraft surfaces and components as described in the United Flight Operations Manual, Adverse Weather Chapter.

FIGURE 03 - INSPECTION OF AIRCRAFT CRITICAL SURFACES



G. **Successful Inspection**

(1) At the conclusion of a successful inspection the pilots will be notified by the Snowflake Observer that the critical surfaces are free of contaminates.

H. **Failed Inspection**

(1) Snowflake observers shall utilize the following criteria to recognize deicing / anti-icing fluid failure and / or contamination:

(2) Anti-ice fluids are considered to have "failed" and to have lost their effectiveness when they become diluted with falling precipitation to the point where the contaminates become visible in the fluid. When this occurs, the fluid begins to appear "opaque" rather than transparent

and glossy and / or the inability to discern structural details (rivets, screws, seams) through the fluid becomes apparent.

(3) Additional indications for loss of effectiveness of deicing / anti-icing fluid or contamination of aircraft surfaces include:

(a) Progressive surface freezing or snow accumulation.

(b) Random snow accumulation.

(c) Dulling of surface reflectivity (loss of gloss) caused by the gradual deterioration of the fluid to slush.

(4) At the conclusion of a failed inspection the pilots will be notified by the Snowflake Observer that the critical surfaces appear to be contaminated.

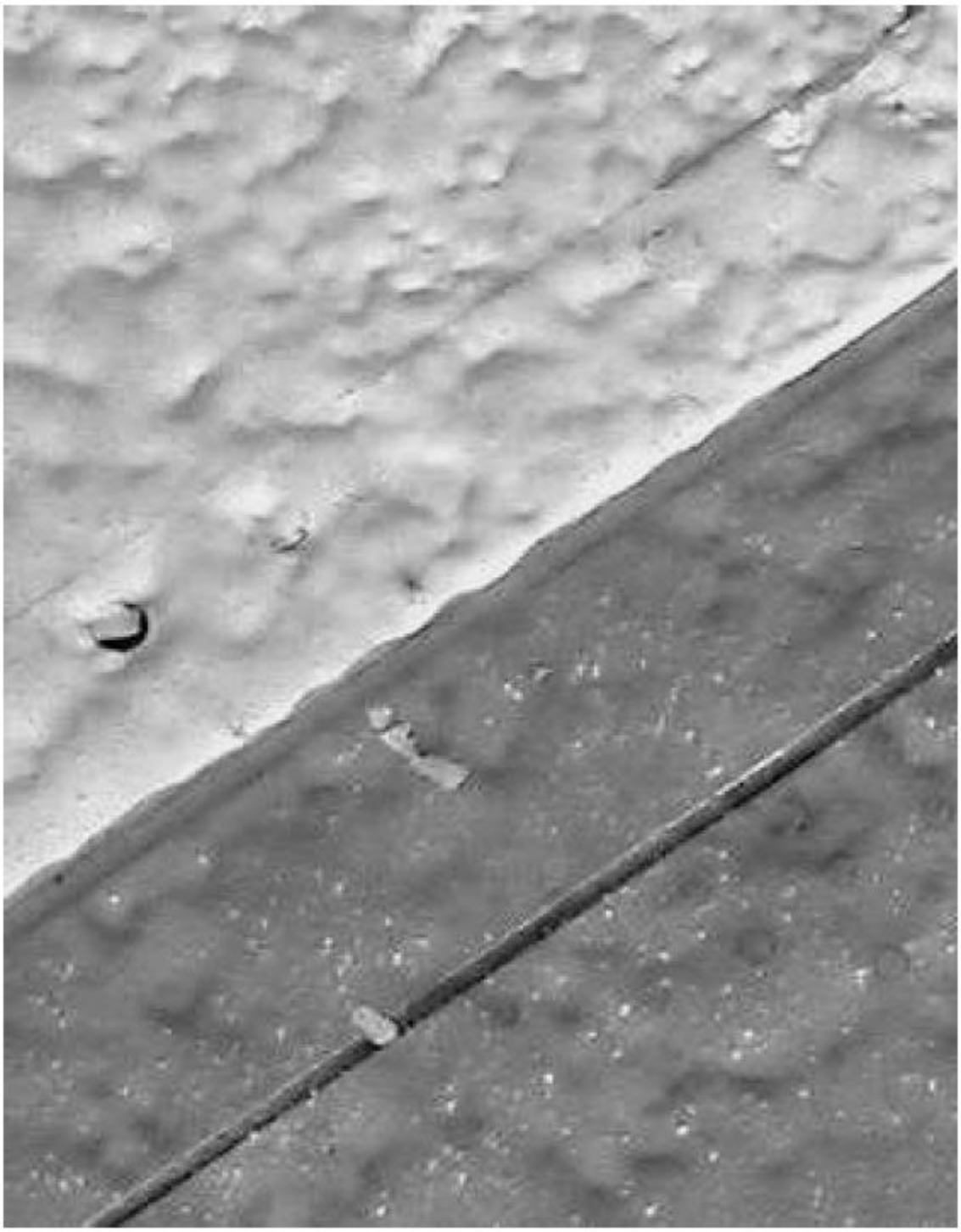
(5) The following pictures are examples of failed Type IV anti-icing fluid.

(6) In the following picture, you can see bands of glossy fluid and fluid that has started to absorb precipitation. The failed fluid has a dull, opaque appearance.

FIGURE 04 - FAILED TYPE IV ANTI-ICING FLUID BANDS

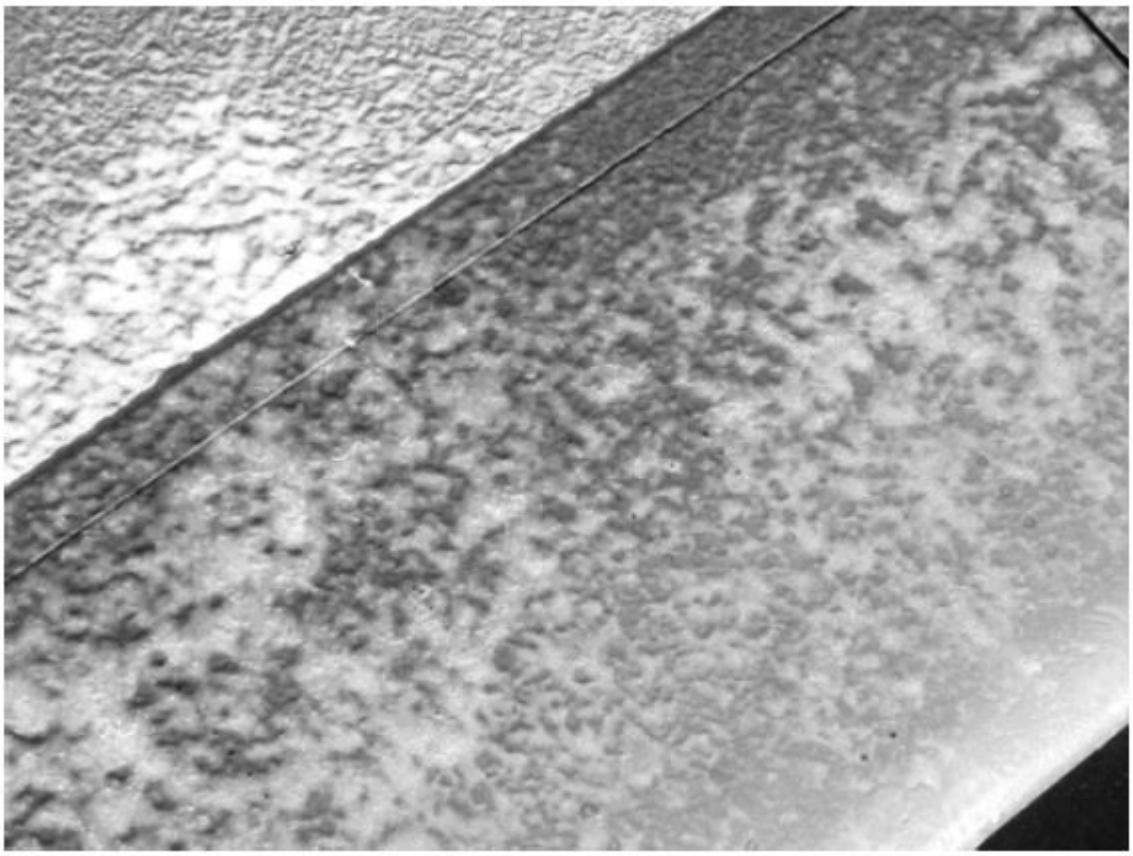
(7) The following picture shows a close up of failed fluid. You can see that the fluid is not smooth, but becomes rough and “blotchy”. The fluid is more opaque and details such as seams and rivets cannot be seen.

FIGURE 05 - FAILED TYPE IV ANTI-ICING FLUID CLOSE UP



(8) The following picture shows failed Type IV fluid with ice pellets. Again, the fluid is not uniform in appearance, but appears rough and opaque in areas.

FIGURE 06 - FAILED TYPE IV ANTI-ICING FLUID WITH ICE PELLETS



(9) At the conclusion of an unsuccessful inspection the pilots shall be notified by the Snowflake Observer that contaminants are present on the critical surfaces of the aircraft and that it is Snowflake's recommendation to return for additional deicing / anti-icing as appropriate.

9. **SECTION 5 – PRECIPITATION INTENSITY PROCEDURE**

A. **SECTION 5: Part 1 – Introduction**

(1) A pilot observation that no precipitation is falling is valid and can be used to re-evaluate holdover times or make a determination that a clean aircraft does not require anti-icing. If intensities appear greater than being reported, adjust the holdover time accordingly. For determining the absence of precipitation, reference the windscreen, sky, and / or ambient temperature surfaces such as ramps, taxiways, buildings, vehicles, other structures, or any other tools available to the crew.

B. **SECTION 5: Part 2 – Background**

(1) Under some precipitation conditions, current methods used by weather observers, or electronic measuring systems, to determine precipitation intensities could lead to over-stating or under-stating the actual intensity rate. Often weather observers determine precipitation intensities levels by the size and coverage of the precipitation on the ground or by its effects on the prevailing visibility. When precipitation is present with other obstructions to visibility such as fog or mist, the intensity level of the precipitation may be overstated. This is particularly common for ice pellet conditions where no accurate method of electronically measuring intensity levels is currently in use.

C. **SECTION 5: Part 3 – Snowflake Precipitation Intensity Procedures**

(1) Pilots may request assistance in obtaining precipitation intensity information. Snowflake can assist the pilots in determining the following:

(a) No precipitation is falling

(b) Precipitation intensity is greater than reported

(2) Pilots and Snowflake are not authorized to determine if precipitation rates are lower than reported.

COLD WEATHER OPERATION - 737

Reference 737 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”.

COLD WEATHER OPERATION - 757/767

Reference 757-767 Flight Manual Chapter 4 Section 10 “Cold Weather Operations”.

COLD WEATHER OPERATION - 777

Reference 777 Flight Manual Chapter 4 Section 10 “Cold Weather Operations”.

COLD WEATHER OPERATION - A319 / 320

Reference 319-320 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”.

COLD WEATHER OPERATION - 787

Reference 787 Flight Manual Chapter 5 Section 10 “Cold Weather Operations”.

PRODUCTS AND ENGINEERING

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PRODUCTS AND ENGINEERING

PRODUCTS AND ENGINEERING

PRODUCTS & ENGINEERING

1. General / Policy Overview

   A. This section contains information on deicing / anti icing products approved for use on United aircraft.

2. Purpose

   A. This section provides directions for acceptance, handling and storage of all de / anti-icing products.

3. Scope

   A. This information covers all United personnel and Service Providers who perform all deicing related activities on United aircraft.

4. Deicing and Anti-icing Products

   A. General

      (1) This section describes approved materials for deicing. It details the procedures for receiving these materials and storing them in tanks and trucks. It also indicates how to select measure and adjust the concentration of the deicing materials.

      (2) Deicing materials are chemical products, which are applied on the aircraft exterior surface to remove frost, ice, and snow or slush accumulation.

      (3) The recommended and predominantly used materials are diluted hot Type I glycol based deicing fluids and cold undiluted anti-icing Type II, III and IV fluids.

         (a) Type I – An un-thickened fluid that forms very thin film on aircraft surfaces and is liquid enough to help wash affected areas clean, but viscous enough to adhere in a thin film and provide limited protection against new accumulation. Type I fluids are typically orange in color, but may be clear (e.g., Japan).

         (b) Type II - Thickened fluids that decrease in viscosity when subjected to shear forces during the takeoff roll. The fluid provides a longer Holdover Time (HOT) during freezing precipitation. Most Type II fluids are yellow in color.

         (c) Type III – Designed for aircraft with low rotation speeds and provides better anti-icing performance than Type I fluid. Type III fluid is bright yellow in color. Type III fluid may be used for United deicing operations.

         (d) Type IV - Enhanced performance fluid that contains a thickening agent that enables the fluid to form a thicker film on aircraft surfaces. This film provides a longer HOT, especially in conditions of freezing precipitation. These fluids are green in color, but may be clear (e.g., Japan).

      (4) United Engineering is responsible for reviewing and approving all aircraft deicing and anti-icing fluids used on United aircraft, both inside and outside the United States. All fluids are reviewed by United Engineering per FAA guidance documentation as well as the United Chemical review process, as documented on the United Engineering Website. Once a fluid is determined to meet our requirements Engineering approves it for use on United aircraft and updates the list of approved fluids.

(5) United does not directly purchase Ethylene Glycol (EG) based aircraft deicing / anti-icing fluids from the manufacturer for use domestically on aircraft.

5. Approved Type I Glycol Based Deicing Fluids

A. Type I Deicing Fluids:

	Manufacturer Name	Brand Name	Type of Glycol Base
1	ABAX Industries	DE-950	PG
2	AllClear Systems LLC	Lift-Off E-188	EG
3	AllClear Systems LLC	Lift-Off P-88	PG
4	Aviation Shaanxi Hi-Tech Physical Chemical Co. Ltd.	Cleanwing I	PG
5	Aviation Xi'an High-Tech Physical Chemical Co. Ltd.	KHF-1	PG
6	Chemco Inc.	CHEMR EG I	EG
7	Chemco Inc.	CHEMR REG I	EG
8	Clariant Produkte (Deutschland) GmbH	Octaflo EF Concentrate	PG
9	Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO	PG
10	Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO (80)	PG
11	Clariant Produkte (Deutschland) GmbH	Safewing MP I 1938 ECO (80) Premix 55% i.g. ready-to-use	PG
12	Clariant Produkte (Deutschland) GmbH	Safewing MP I ECO Plus (80)	PG
13	Clariant Produkte (Deutschland) GmbH	Safewing MP I LFD 88	PG
14	Clariant Produkte (Deutschland) GmbH	Safewing MP I LFD (80)	PG
15	Cryotech Deicing Technology	Polar Plus	PG
16	Cryotech Deicing Technology	Polar Plus LT	PG
17	Cryotech Deicing Technology	Polar Plus LT (80)	PG

	Manufacturer Name	Brand Name	Type of Glycol Base
18	Cryotech Deicing Technology	Polar Plus (80)	PG
19	Inland Technologies	SafeTemp ES Plus	PG
20	Dow Chemical Company	UCAR™ ADF Concentrate (EG)	EG
21	Dow Chemical Company	UCAR™ ADF XL54[17]	EG
22	Dow Chemical Company	UCAR™ PG ADF Concentrate	PG
23	Dow Chemical Company	UCAR™ PG ADF Dilute 55/45[18]	PG
24	HOC Industries	SafeTemp ES Plus	PG
25	Inland Technologies, Canada, Inc.	Inland ADF Concentrate	EG
26	Kilfrost Limited	DF Plus	PG
27	Kilfrost Limited	DF Plus (80)	PG
28	Kilfrost Limited	DF Plus (88)	PG
29	Kilfrost Limited	DF^{Sustain}	*Non-Conventional*
30	LNT Solutions	LNT E188	EG
31	LNT Solutions	LNT P180	PG
32	LNT Solutions	LNT P188	PG
33	Newave Aerochemical Co. Ltd.	FCY-1A	EG
34	Shaanxi Cleanway Aviation Chemical Co. Ltd.	Cleansurface I	EG

B. United approved Type I glycol based deicing fluids are qualified AMS 1424 products and qualified by FAA and comply with aircraft manufacturers requirements.

CAUTION: **TYPE I FLUIDS, SUPPLIED AS CONCENTRATES, SHALL NOT BE USED UNDILUTED, UNLESS THEY MEET AERODYNAMIC PERFORMANCE AND FREEZING POINT (FP) BUFFER REQUIREMENT.**

C. Temperature conditions for use of fluid are in this chapter and are based on an 18°F (10°C) buffer between fluid FP and outside air temperature (OAT).

D. The lowest operational use temperature (LOUT) limitation indicated in this chapter is related to aerodynamic performance restrictions.

CAUTION: **AS EACH FLUID HAS IT'S OWN LOUT, IT WILL ALSO HAVE IT'S OWN MAXIMUM FLUID MIXTURE RATE. MIXTURE RATES ABOVE THIS FLUID / WATER RATIO HAVE NOT BEEN TESTED AND ARE NOT ALLOWED.**

E. Aircraft deicing fluids are normally colored orange or red / orange but may be clear in some countries.

F. Service Providers may not use deicing / anti-icing fluids that are different from United's approved fluids though they may be qualified by the current FAA Notice. These will require approval from United Engineering.

G. In-Truck Manufacturing of Type I Deicing Fluid:

(1) The following outlines the requirements for In-Truck manufacturing of Type I deicing fluid through in-line blending of components of the deicing fluid.

(2) The final Type I aircraft deicing fluid is sprayed directly upon the aircraft after manufacturing.

(3) An In-Truck system manufactures Type I fluid immediately prior to the fluid being applied to the aircraft.

(4) The manufacturing system will blend the final fluid using three (3) components: freezing point depressant, water, and an additive component (ad-pack).

(a) The additive component manufacturer has the overall responsibility for the development, testing, and qualification of the additive component and the final fluid according to AMS 1424. The additive component manufacturer defines the ratios and tolerances for the blending with freeze point depressant and water. The additive component manufacturer has the responsibility to ensure the final Type I fluid meets the quality requirement for the Type I fluid, when the components are mixed within the defined ratios and tolerances, described by the additive component manufacturer.

(b) The manufacturer of the In-Truck manufacturing system is responsible for ensuring the system consistently blends the fluid to the specification of the additive component manufacturer. The manufacturer of the In-Truck manufacturing system has to define required service, maintenance and test procedures and intervals, to assure the system is operating within the tolerances for the mixing of the components to fulfill the additive component manufactures specifications.

(c) The operator is responsible for ensuring the In-Truck manufacturing system is operated in accordance with these requirements, the requirements defined by the additive component manufacturer for mixing of the additive component, and the requirements defined by the manufacturer of the In-Truck manufacturing system.

(d) Type I deicing / anti-icing fluid development and qualification. The manufacturer of the additive component used to produce the Type I deicing / anti-icing fluid is responsible for the development and qualification of the additive component and the final fluid according to the requirements in AMS1424. Fluid submitted for initial qualification must be collected from the deicing truck nozzle after ensuring proper operation of the system and a sufficient quantity of fluid has been purged before sample collection. The manufacturer of the additive component has to secure the storage and thermal stability of the additive component according to the requirements for the final fluid in AMS 1424 (suggest referencing the appropriate section of AMS1424). The additive component manufacturer shall define the volume / mass ratios and tolerances for

mixing the additive component with freeze point depressant and water. The ratio and tolerance must be verified in the initial testing of the fluid and additive component.

6. Alternate Deicing Materials

A. Water

(1) Under certain conditions heated water may be used to deice aircraft.

CAUTION: **A REPRESENTATIVE OF THE CORPORATE WINTER OPERATIONS COMMITTEE (CWOC) CORE MUST BE CONSULTED PRIOR TO IMPLEMENTATION OF THIS PROCEDURE. CWOC MEMBER NAMES AND PHONE CONTACTS MAY BE FOUND WITHIN THE WINTER OPERATIONS SHAREPOINT.**

B. Hot Type II, III or IV Fluid Mixed With Water

(1) A heated mixture of Type II, III or IV fluid and water can be used as a deicing fluid. All methods of operation for Type I fluids apply.

CAUTION: **THE REPEATED APPLICATION OF TYPE II, III OR IV MAY CAUSE RESIDUES TO COLLECT IN AERODYNAMICALLY QUIET AREAS, CAVITIES AND GAPS. THE APPLICATION OF HOT WATER OR HEATED TYPE I FLUID IN THE FIRST STEP OF THE DEICING / ANTI-ICING PROCESS MAY MINIMIZE THE FORMATION OF RESIDUES. RESIDUE MAY RE- HYDRATE AND FREEZE UNDER CERTAIN TEMPERATURE, HIGH HUMIDITY AND / OR RAIN CONDITIONS AND MAY BLOCK OR IMPEDE CRITICAL FLIGHT CONTROL SYSTEMS. THESE RESIDUES MAY REQUIRE REMOVAL.**

7. Fluid Transition (When Changing Fluid Manufacturers)

A. Contact the CWOC and the new vendor for guidelines on maximum fluid mixing ratios between the old and new fluids.

(1) The industry experience is that Type I fluids are generally compatible, with a maximum 5-10% remnant of prior fluid as specified by new fluid manufacturer. If the manufacturer specification is more restrictive the requirements contact the Winter Operations Core Committee for direction.

(2) Placarding must be done according to United policy with the new vendor fluid.

(3) Reduce previous vendor fluid content in the storage as much as possible to specified residual percentage with water rinse if advised by fluid manufacturer, without compromising pump priming.

(4) No purging of lines is required.

8. Type I Fluid Receipt – New Deliveries

A. Fluid handling is an important part of the deicing operation process. The acceptance of fluids must include such items as the fluid quality testing, certificates of analysis, batch and shipment documents etc. Personnel accepting deicing / anti-icing fluids must be trained and certified. Before filling the tank with the deicing fluid it shall be established that the brand name and the concentration of the product mentioned in the packing list corresponds to the brand name and the concentration mentioned in the storage tank. For bulk deliveries a sample of the delivered product must be taken and checked from each tanker before the storage tank is filled. For tote

or barrel deliveries the totes may remain sealed. Fluid shall be tested as part of the daily deicer user check process prior to use.

(1) Perform the delivery check for deicing fluids as follows:

(a) Appearance – Visually check the color for conformity, visually check for solid contamination. (For bulk tanker deliveries only or if opening a tote or barrel)

(b) Perform a refractive index check. (For bulk tanker deliveries only or if opening a tote or barrel)

1 Verify reading is within tolerance as stated on the corresponding Fluid Reference Chart.

(c) If any check fails contact CWOC Core and Fluid Manufacturer.

(d) Document results on applicable form.

(e) See 09-01-01 Documentation for requirements.

9. Filling Deicer Trucks

A. Prior to a Type I Deicer tank receiving fluid, water or a mixture of fluid and water, check the fluid FP of the dispensing tank or unit.

CAUTION: **CIRCULATE THOROUGHLY BEFORE MEASURING FLUID FP.**

B. Use Aircraft Deicing / Anti-icing Program (ADAP) 18°F (10°C) Buffer Rule to select the desired concentration, this is the leanest mixture consistent with OAT and weather conditions for the particular deicing fluid used.

CAUTION 1: **NEVER USE A LEANER FLUID MIXTURE THAN REQUIRED. HOWEVER, LOCAL MANAGEMENT MAY ELECT TO USE A RICHER FLUID MIXTURE THAN REQUIRED BY OAT.**

CAUTION 2: **NEVER GO BEYOND THE CHART'S LOUT.**

10. Approved Type II, III and IV Glycol Based Anti-icing Fluids

A. Type II Anti-Icing Fluids:

	Manufacturer Name	Brand Name	Type of Glycol Base
35	Aviation Shaanxi Hi-Tech Physical Chemical Co. Ltd.	Cleanwing II	PG
36	Clariant Produkte (Deutschland) GmbH	Safewing MP II FLIGHT	PG
37	Cryotech Deicing Technology	Polar Guard II	PG
38	Kilfrost Limited	ABC-K Plus	PG
39	Newave Aerochemical Co. Ltd.	FCY-2	PG

B. Type III Anti-Icing Fluids:

	Manufacturer Name	Brand Name	Type of Glycol Base
40	AllClear Systems LLC	AeroClear MAX	EG

C. Type IV Anti-Icing Fluids:

	Manufacturer Name	Brand Name	Type of Glycol Base
41	ABAX Industries	Ecowing AD-49	PG
42	Chemco Inc.	CHEMR EG IV	EG
43	Chemco Inc	ChemR Nordik IV	EG
44	Clariant Produkte (Deutschland) GmbH	Safewing MP IV LAUNCH	PG
45	Clariant Produkte (Deutschland) GmbH	Safewing MP IV Launch Plus	PG
46	Cryotech Deicing Technology	Polar Guard Advance	PG
47	Cryotech Deicing Technology	Polar Guard Xtend	PG
48	Dow Chemical Company	UCAR Endurance EG106 De/Anti-Icing Fluid	EG
49	Dow Chemical Company	UCAR FlightGuard AD 49	PG
50	Inland Technologies	ECO-SHIELD	PG
51	Kilfrost Limited	ABC-S Plus	PG
52	Newave Aerochemical Co. Ltd.	FCY 9311	PG

D. General

(1) This section describes approved anti-icing materials and related equipment and storage. This section also overviews the procedures for receiving these materials and storing them in tanks and trucks.

(2) Anti-icing materials are chemical products applied to the aircraft exterior surface which provide protection against the formation of frost, ice and accumulation of snow or slush on clean surfaces of the aircraft for a limited period of time (HOT).

(3) The recommended and predominantly used materials at United are undiluted cold Type IV glycol based anti-icing fluids. These fluids have been specifically designed for the anti-icing task.

(4) Within the list of approved Type IV fluids, the HOTs vary among the fluid manufacturers and products. Therefore, management at each station must determine which fluid is preferred depending on HOT requirements, such as taxi times, etc. At stations with Service Providers, United management in consultation with Service Provider management will determine the approved fluid to be used.

E. Approved Fluids

(1) United approved Type II, III and IV glycol based anti-icing fluids are qualified AMS 1428 products, qualified by the FAA and comply with aircraft manufacturer's requirements and approved by United Engineering. Approved products are listed in ADAP.

CAUTION: **FLUIDS MEETING THE AMS 1428 SPECIFICATION ARE UNIQUE TO EACH OTHER AND ARE LIKELY TO BE ADVERSELY AFFECTED BY MIXING WITH OTHER AIRCRAFT DEICING / ANTI-ICING FLUIDS.**

(2) Type IV fluids generally have longer freezing precipitation protection time (HOT) than Type II or III fluids.

(3) Fluid colors normally are:

(a) Type II - yellow

(b) Type III - bright yellow

(c) Type IV - green.

(4) Type II, III and IV use is restricted at low OAT by aerodynamic performance. The LOUT of these fluids is in ADAP.

(5) Type II, III and IV anti-icing fluid effectiveness can be physically and chemically damaged (degraded) as a result of pumping, heating and spraying in equipment not designed for these fluids.

(6) Service Providers must use deicing / anti-icing fluids approved by United Engineering.

F. Alternate Anti-icing Materials

(1) Deicing Fluids

(a) Approved Type I glycol based deicing fluids are also approved anti-icing fluids. Their protection against the formation of frost, ice and accumulation of snow or slush is minimal.

1 Heated diluted Type II, III or IV fluids are approved deicing / anti-icing fluids. They are subject to the same checks and controls as concentrated Type I fluids. If Type II, III or IV is diluted with water, heated and used as deicing / anti-icing fluid, as a best practice the FP should be placarded on the facility tank exterior. Deicer's FP will be determined by refracting the diluted fluid prior to use.

2 Type II, III or IV fluids which are stored in a heated tank will be tested daily when in use for Refractive Index.

NOTE: **Check the Fluid Reference Charts to determine which fluids can be diluted and which cannot.**

G. Fluid Transition (When Changing from one Fluid to Another)

CAUTION: **FLUIDS MEETING THE AMS 1428 SPECIFICATION ARE UNIQUE TO EACH OTHER AND ARE LIKELY TO BE ADVERSELY AFFECTED BY MIXING WITH OTHER AIRCRAFT DEICING / ANTI-ICING FLUIDS.**

(1) Before transitioning your Type II, III or IV fluid, contact CWOC Core for transition procedures from the new fluid manufacturer. In the absence of procedures from the new manufacturer, follow the procedures below:

(a) Purge storage of the previous anti-icing fluid.

(b) Clean the storage completely with clean water.

(c) Drain water.

(d) Placard according to the new vendor fluid.

H. Pre-Season Fluid Readiness Check

(1) A Pre-Season Laboratory Readiness Check of Type II, III or IV fluid, which is stored from the prior season in unsealed containers (bulk storages, deicer tanks, totes or drums), is required once per year just prior to station winter readiness date. Fluid stored in a manufacturer's sealed tote or drum is not required until the fluid is two (2) years old from receipt of fluid. After two (2) years the seal must be broken, and the fluid tested. This check determines the performance level of the fluids. It also allows the tanks to be checked annually for corrosion and contamination.

(a) This Laboratory test will include a test on Viscosity, pH, Refractive Index and Appearance.

CAUTION: **SOME TANKS DO NOT HAVE PROPER PLATFORMS AND RAILINGS TO SAFELY PROTECT THE INDIVIDUAL DURING SAMPLING. ON THESE TANKS USE OF AN OPEN BASKET DEICER WITH PROPER HARNESS AND LANYARD IS AN ACCEPTABLE PRACTICE FOR ACCESSING THE TOP HATCH.**

(2) Service Providers must accomplish testing requirements per storage of Type II, III or IV fluid during the preseason. If the fluid is tested by an independent lab certified to perform the required test of Laboratory Quality Control, the fluid manufacturer or another Air Carrier with an approved deicing / anti-icing program, a copy of the report will be uploaded into the Winter Operations Management Program.

(3) Complete a Refractive Index and Fluid appearance check as it provides an indication of tank corrosion. Fluid discoloration particle content, sedimentation and / or separation indicates tank corrosion and / or contamination. If corrosion or contamination is evident, notify United Ground equipment. This check will be performed by a deicing trained and certified individual.

NOTE: **Although deicing / anti-icing fluids are generally non-corrosive, their vapor can be corrosive. To minimize corrosion at the liquid / vapor interface and in the vapor space, a high liquid level in the tanks is recommended.**

(4) The viscosity of Type II, III and IV fluid can decrease over time resulting in reduced freezing precipitation protection. This will be detected on the station Pre-Season Readiness Check sample.

(5) Obtain Sample and process per Anti-icing Fluid Tank Sampling Process found on the Winter Operations SharePoint or accredited laboratory.

(6) Upon return of the laboratory report, ensure that all test results of each control are within acceptable limits. In case of “no approval” appropriate action must be taken according to failed fluid procedure in Anti-icing Failed Fluid Procedures.

(7) The Laboratory Quality Control report will be held electronically on the Winter Operations Management Program website.

(8) A sample of the fluid will be sent to United Engineering or accredited laboratory, tested by an independent lab certified to perform the Laboratory Quality Control requirements, the fluid manufacturer or another Air Carrier with an approved deicing / anti-icing program.

I. Deicer Anti-ice System Test Procedure (Nozzle Test)

(1) The integrity of the deicer anti-icing systems is tested annually as determined by United Engineering. Upon notification by United Engineering perform test procedures found in the training material. Service Providers must also have a Deicer System Test Policy approved by the CWOC.

J. The Laboratory Quality Control report will be held electronically on the Winter Operations Management Program website.

K. Anti-icing Failed Fluid Procedures

(1) If a Type II, III or IV fluid fails, the fluid storage must be quarantined, and a red Out of Service Tag shall be attached until United Engineering approves appropriate action.

(2) If time allows, the station should request confirmation and perform a re-sampling. There are several reasons to expect different results from the re-sample. Sometimes the sampling itself was inadequate; sample must be taken from the middle of the storage to be representative, it may have been taken at the surface where special behavior occurs or taken out of a spraying nozzle. Also, the shipping may cause the shearing of fluid, particularly when the sample bottle is only partly filled.

(3) In case of confirmed fluid failure, the station should request replacement by the supplier if the initial delivery is less than two years old and appropriate storage precautions were in place.

(4) A sample may be sent to the supplier to duplicate United Engineering results or to provide expert advice. However, a supplier recommendation, not specifically indicated in United Procedures, shall never be implemented without approval by United Engineering.

(5) Failed anti-icing fluid should be returned to manufacturer, transferred to recycler, used for de / anti-icing training, or discarded.

(6) Disposal of failed Type II, III or IV, must be performed in compliance with local waste effluent regulation.

(7) Environmental Requirements: Even though PG is biodegradable, all storage and disposal procedures detailed in the Safety Data Sheet (SDS), Environmental Protection Agency (EPA) and other government regulations and United Environmental Affairs procedures must be followed for all of these fluids. Consistent with this, no deicing / anti-icing fluid should be allowed to flow into sewers or public waters.

L. Type II, III and IV Anti-icing Fluid Receipt

(1) Fluid handling is an important part of the anti-icing operation process.

(a) The acceptance of fluids must include such items as the:

1 Fluid quality testing,

2 Certificates of analysis,

3 Batch and shipment documents, etc.

(b) Before filling the tank with the anti-icing fluid it shall be established that the brand name and the concentration of the product identified on the packing list corresponds to the brand name and the concentration identified on the storage tank. A sample of the delivered product must be taken and checked from each tanker, tote and barrel before the storage tank / vehicle is filled.

(c) If totes or barrels are not being opened as part of the delivery process then daily testing, prior to use, of the type IV refractive index in deice truck tanks shall be completed as part of the daily deicer user check.

(2) Perform the delivery check for anti-icing fluids as follows:

(a) Appearance – visually check the color for conformity, visually check for solid contamination (For bulk tanker deliveries only or if opening a tote or barrel)

(b) Perform a refractive index check (For bulk tanker deliveries only or if opening a tote or barrel)

1 Verify reading is within tolerance as stated on the corresponding Fluid Reference Chart

2 If check fails, contact CWOC Core and Fluid Manufacturer.

(c) Document results as applicable.

(d) See 09-01-01 Documentation for requirements.

M. Laboratory Quality Control

(1) The Lab performs the following tests according to manufacturer's specifications:

(a) Appearance – visually check the color for conformity, visually check for solid contamination

(b) pH – maintain readings within manufacturer's specifications

(c) Refractive Index – maintain readings within manufacturer's specifications

(d) Viscosity – maintain readings within manufacturer's specifications

(2) A report indicating the results and approval, or disapproval will be made available to the station and it will be kept in the Winter Operations Management Program website.

11. Runway Deicers

A. Runway deicers are NOT approved material for deicing aircraft. Their use shall be restricted to ramp and taxi deicing. Approved United Runway Deicers are compatible with aircraft materials in order to be allowed for use around the aircraft (airside).

B. Products meeting the requirements of SAE AMS 1431 for solids or SAE AMS 1435 for liquids (latest revision) are acceptable for use as runway deicers conditional to United Engineering approval.

C. Further chemical data can be found on the United chemical database. A link for the database can be found on the Engineering Technical Information Center webpage and on the Winter Operations SharePoint.

NOTE: **UREA is NOT approved for airside application unless approved by United Engineering.**

CAUTION: **RUNWAY DEICERS HAVE NO RATED PROTECTION TIME (HOT) AGAINST ICE FORMATION. DO NOT USE AS A DEICING OR ANTI-ICING FLUID.**

12. Fluid Reference Charts

A. Approved Type I Fluids:

1. DE-950

Brand Name DE-950 Type I
Manufacturer ABAX

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 71%
Max. Refractive Index No: 1.4005
Max. Brix No: 40.25
2. Minimum LOUT (Lowest Operational Use Temperature): -23 °F (-31 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11076
7. Field Test Acceptability:

Concentrate - Brix	49.25 - 50.67	Refractive Index	1.4185 - 1.4215	pH	7.0 - 8.0
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
63/37 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.4200	MUST BE DILUTED		49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			-16
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			-7
75/25	1.3990			24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			-2
60/40			-34	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.3800		-24				

2. Lift-Off E-188

Brand Name: Lift-Off E-188 — Type I
Manufacturer: AllClear Systems

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70% — Max. Refractive Index No: 1.393 — Max. Brix No: 39.2
2. Minimum LOUT (Lowest Operational Use Temperature): -41.5 °F (-42.7 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: EG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	39.2 - 11.7	Refractive Index	1.4165 - 1.4195	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.3690	-15	-26
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.3680	-11	-24
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.3640	-9	-23
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.3570	9	-13
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.3500	16	-9
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3480	19	-7
70/30	1.3930	-62	-52	19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35	1.3900	-62	-52	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40	1.3850	-49	-45	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45	1.3820	-38	-39	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.3760	-26	-32				

3. Lift-Off P-88

Brand Name: Lift-Off P-88 — Type I
Manufacturer: AllClear Systems

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70% — Max. Refractive Index No: 1.401 — Max. Brix No: 40.8
2. Minimum LOUT (Lowest Operational Use Temperature): -21.1 °F (-29.5 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	No Data	Refractive Index	1.4235 - 1.4265	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3820	-17	-27
99/1				48/52	1.3810	-15	-26
98/2				47/53	1.3800	-13	-25
97/3				46/54	1.3790	-11	-24
96/4				45/55	1.3780	-9	-23
95/5				44/56	1.3772	-8	-22
94/6				43/57	1.3764	-7	-21
93/7				42/58	1.3756	-5	-21
92/8				41/59	1.3748	-4	-20
91/9				40/60	1.3740	-2	-19
90/10				39/61	1.3730	-1	-18
89/11				38/62	1.3720	1	-17
88/12				37/63	1.3710	2	-17
87/13				36/64	1.3700	4	-16
86/14				35/65	1.3690	5	-15
85/15				34/66	1.3684	6	-15
84/16				33/67	1.3678	6	-14
83/17				32/68	1.3672	7	-14
82/18				31/69	1.3666	8	-13
81/19				30/70	1.3660	9	-13
80/20				29/71	1.3642	10	-12
79/21				28/72	1.3624	12	-11
78/22				27/73	1.3606	14	-10
77/23				26/74	1.3588	16	-9
76/24				25/75	1.3570	18	-8
75/25				24/76	1.3564	18	-8
74/26				23/77	1.3558	18	-8
73/27				22/78	1.3552	19	-7
72/28				21/79	1.3546	19	-7
71/29				20/80	1.3540	19	-7
70/30				19/81	1.3534	20	-7
69/31				18/82	1.3525	21	-6
68/32				17/83	1.3515	21	-6
67/33				16/84	1.3506	22	-6
66/34				15/85	1.3496	23	-5
65/35	1.3970	-56	-49	14/86	1.3487	23	-5
64/36	1.3962	-53	-47	13/87	1.3477	24	-5
63/37	1.3954	-50	-46	12/88	1.3468	24	-4
62/38	1.3946	-48	-44	11/89	1.3458	25	-4
61/39	1.3838	-45	-43	10/90	1.3449	26	-4
60/40	1.3930	-42	-41	9/91	1.3439	26	-3
59/41	1.3920	-39	-40	8/92	1.3430	27	-3
58/42	1.3910	-37	-38	7/93	1.3420	28	-2
57/43	1.3900	-34	-37	6/94	1.3410	28	-2
56/44	1.3890	-32	-35	5/95	1.3401	29	-2
55/45	1.3880	-29	-34	4/96			
54/46	1.3870	-27	-33	3/97			
53/47	1.3860	-25	-32	2/98			
52/48	1.3850	-23	-30	1/99			
51/49	1.3840	-21	-29	0/100			
50/50	1.3830	-18	-28				

4. Cleanwing I

Brand Name: Cleanwing I — Type I
Manufacturer: Aviation Shaanxi High-Tech

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:

Max. concentrate % in mixture:	Max. Refractive Index No:	Max. Brix No:
75%	1.419	49.5

2. Minimum LOUT (Lowest Operational Use Temperature): -38 °F (-39 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Colorless/Pale Yellow 5. Base: PG/Glycerin 6. Spec: AMS 1424/1
7. Field Test Acceptability:

Concentrate - Brix	48.00 - 49.50	Refractive Index	1.4160 - 1.4190	pH	8.5 - 9.5
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
63/37 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.4183			49/51	1.3762		
99/1				48/52	1.3752		
98/2				47/53	1.3744		
97/3				46/54	1.3735		
96/4				45/55	1.3726		
95/5				44/56	1.3717		
94/6				43/57	1.3709		
93/7				42/58	1.3701		
92/8				41/59	1.3688		
91/9				40/60	1.3674		
90/10				39/61	1.3666		
89/11				38/62	1.3658		
88/12				37/63	1.3650		
87/13				36/64	1.3642		
86/14				35/65	1.3633		
85/15				34/66	1.3627		
84/16				33/67	1.3617		
83/17				32/68	1.3610		
82/18				31/69	1.3602		
81/19				30/70	1.3593		
80/20	1.4020			29/71	1.3584		
79/21	1.4012			28/72	1.3575		
78/22	1.4003			27/73	1.3568		
77/23	1.3994			26/74	1.3557		
76/24	1.3985			25/75	1.3532		
75/25	1.3980			24/76	1.3541		
74/26	1.3970			23/77	1.3532		
73/27	1.3959			22/78	1.3522		
72/28	1.3948			21/79	1.3513		
71/29	1.3943			20/80	1.3604		
70/30	1.3937			19/81			
69/31	1.3929			18/82			
68/32	1.3921			17/83			
67/33	1.3913			16/84			
66/34	1.3905			15/85			
65/35	1.3897			14/86			
64/36	1.3888			13/87			
63/37	1.3881			12/88			
62/38	1.3874			11/89			
61/39	1.3867			10/90			-2
60/40	1.3859			9/91			
59/41	1.3849			8/92			
58/42	1.3839			7/93			
57/43	1.3831			6/94			
56/44	1.3823			5/95			
55/45	1.3815			4/96			
54/46	1.3807			3/97			
53/47	1.3798			2/98			
52/48	1.3788			1/99			
51/49	1.3780			0/100			0
50/50	1.3772						

5. KHF-1

Brand Name: KHF-1 — Type I
Manufacturer: Aviation Xi'an High-Tech

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 75% — Max. Refractive Index No: 1.408 — Max. Brix No: 44.11
2. Minimum LOUT (Lowest Operational Use Temperature): -37.3 °F (-38.5 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	53.24 - 54.63	Refractive Index	1.4270 - 1.4300	pH	8.5 - 9.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.3784	-16	-27
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.3738	-9	-23
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.3680	-1	-19
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.3635	5	-15
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.3576	11	-12
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3532	14	-10
70/30	1.4033	-81	-63	19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35	1.3991	-63	-53	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40	1.3939	-49	-45	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45	1.3884	-37	-38	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.3835	-27	-33				

6. CHEMR EG I

Brand Name CHEMR EG I Type I
Manufacturer Chemco Inc

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70%
Max. Refractive Index No: 1.398
Max. Brix No: 39
2. Minimum LOUT (Lowest Operational Use Temperature): -45 °F (-43 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: EG 6. Spec: AMS 1424K & ISO 11076
7. Field Test Acceptability:

Concentrate - Brix	49 - 52	Refractive Index	1.418 - 1.426	pH	7,2 - 8,8
75/25 Dilution - Brix	32,0 - 36,0	Refractive Index	1,383 - 1,393	pH	7,0 - 8,5
55/45 Dilution - Brix	29,0 - 33,0	Refractive Index	1,370 - 1,390	pH	7,0 - 8,5

Source:Chemco (claude.grenon@chemco-inc.com)

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.4220	MUST BE DILUTED		38/62	1.3690	2	-19
75/25	1.4000	MUST BE DILUTED		37/63	1.3670	0	-18
70/30	1.3980	-64	-53	36/64	1.3660	1	-17
69/31	1.3970	-62	-52	35/65	1.3650	3	-16
68/32	1.3960	-60	-51	34/66	1.3640	5	-15
67/33	1.3940	-56	-49	33/67	1.3630	5	-15
66/34	1.3920	-53	-47	32/68	1.3630	7	-14
65/35	1.3910	-51	-46	31/69	1.3620	7	-14
64/36	1.3910	-51	-46	30/70	1.3610	7	-14
63/37	1.3895	-49	-45	29/71	1.3600	9	-13
62/38	1.3900	-49	-45	28/72	1.3590	9	-13
61/39	1.3887	-47	-44	27/73	1.3580	10	-12
60/40	1.3880	-45	-43	26/74	1.3570	12	-11
59/41	1.3870	-42	-41	25/75	1.3560	14	-10
58/42	1.3860	-38	-39	24/76	1.3550	16	-9
57/43	1.3850	-35	-37	23/77	1.3540	16	-9
56/44	1.3840	-31	-35	22/78	1.3540	18	-8
55/45	1.3830	-27	-33	21/79	1.3530	18	-8
54/46	1.3830	-27	-33	20/80	1.3520	19	-7
53/47	1.3820	-27	-33	19/81	1.3510	19	-7
52/48	1.3820	-27	-33	18/82	1.3490	21	-6
51/49	1.3810	-26	-32	17/83	1.3480	21	-6
50/50	1.3810	-26	-32	16/84	1.3460	23	-5
49/51	1.3800	-24	-31	15/85	1.3450	23	-5
48/52	1.3790	-20	-29	14/86			
47/53	1.3760	-15	-26	13/87			
46/54	1.3750	-11	-24	12/88			
45/55	1.3740	-9	-23	11/89			
44/56	1.3740	-9	-23	10/90			
43/57	1.3730	-8	-22	9/91			
42/58	1.3720	-8	-22	8/92			
41/59	1.3720	-6	-21	7/93			
40/60	1.3710	-6	-21	6/94			
39/61	1.3700	-4	-20	0/100			

7. CHEMR REG I

Brand Name CHEMR REG I Type I
Manufacturer Chemco Inc

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 75% Max. Refractive Index No: 1.407 Max. Brix No: 42
2. Minimum LOUT (Lowest Operational Use Temperature): -46.3 °F (-43.5 °C) Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: ORANGE 5. Base: EG 6. Spec: AMS 1424K & ISO 11076
7. Field Test Acceptability:

Concentrate - Brix	50.0 - 53.5	Refractive Index	1.420 - 1.4280		pH 7.5 - 8.8
55/45 Dilution - Brix	XX.X - XX.X	Refractive Index	X.XXX - X.XXX		pH X.X - X.X
63/37 Dilution - Brix	XX.X - XX.X	Refractive Index	X.XXXX - X.XXXX		pH X.X - X.X

Source:Chemco inc. (claude.grenon@chemco-inc.com)

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
>65-75	**1.4070**	**<-67**	**<-55**	36/64	1.3680	-2.2	-19
65/35	1.3960	-67.0	-55	35/65	1.3675	-0.4	-18
64/36	1.3950	-65.2	-54	34/66	1.3660	1.4	-17
63/37	1.3940	-61.6	-52	33/67	1.3650	2.9	-16
62/38	1.3930	-59.5	-51	32/68	1.3630	3.7	-16
61/39	1.3920	-54.1	-48	31/69	1.3625	5.0	-15
60/40	1.3910	-50.8	-46	30/70	1.3620	6.8	-14
59/41	1.3895	-49.0	-45	29/71	1.3610	8.1	-13
58/42	1.3890	-46.2	-43	28/72	1.3605	9.2	-13
57/43	1.3880	-43.6	-42	27/73	1.3595	10.4	-12
56/44	1.3870	-41.8	-41	26/74	1.3585	11.3	-11.5
55/45	1.3860	-39.8	-40	25/75	1.3575	12.2	-11
54/46	1.3850	-37.1	-38	24/76	1.3565	14.0	-10
53/47	1.3845	-34.6	-37	23/77	1.3555	14.9	-9.5
52/48	1.3840	-32.8	-36	22/78	1.3550	15.8	-9
51/49	1.3825	-31.0	-35	21/79	1.3535	16.7	-8.5
50/50	1.3820	-28.9	-34	20/80	1.3530	17.6	-8
49/51	1.3810	-26.2	-32	19/81	1.3520	18.5	-7.5
48/52	1.3800	-23.8	-31	18/82	1.3510	19.4	-7
47/53	1.3790	-22.0	-30	17/83	1.3500	20.3	-6.5
46/54	1.3780	-20.2	-29	16/84	1.3490	21.2	-6
45/55	1.3770	-18.4	-28	15/85	1.3480	22.1	-5.5
44/56	1.3760	-16.6	-27	14/86	1.3470	23.0	-5
43/57	1.3750	-14.6	-26				
42/58	1.3745	-12.1	-24.5				
41/59	1.3730	-10.3	-23.5				
40/60	1.3720	-8.5	-22.5				
39/61	1.3710	-6.4	-21				
38/62	1.3700	-5.6	-21				
37/63	1.3690	-4.0	-20				

8. Octaflo EF

Brand Name: Octaflo EF — Type I
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 65%
Max. Refractive Index No: 1.399
Max. Brix No: 39.5
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424/1
7. Field Test Acceptability:

Concentrate - Brix	51.7 - 53.1	Refractive Index	1.4237 - 1.4267	pH	7.8 - 8.7
50/50 Dilution - Brix	35.9 - 37.8	Refractive Index	1.3920 - 1.3955	pH	7.8 - 8.7
55/45 Dilution - Brix	32.7 - 35.9	Refractive Index	1.3860 - 1.3920	pH	7.8 - 8.7

Source: 2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
65/35	1.3970- 1.3990	-65	-54	35/65	1.3685 - 1.3694	5	-15
64/36	1.3960 - 1.3969	-59	-50	34/66	1.3675 - 1.3684	7	-14
63/37	1.3956 - 1.3959	-54	-48	33/67	1.3665 - 1.3674	8	-13
62/38	1.3951 - 1.3955	-49	-45	32/68	1.3655 - 1.3664	9	-12.5
61/39	1.3946 - 1.3950	-45	-43	31/69	1.3645 - 1.3654	10	-12
60/40	1.3935 - 1.3945	-40	-40	30/70	1.3635 - 1.3644	11	-11.5
59/41	1.3924 - 1.3934	-38	-39	29/71	1.3623 - 1.3634	12	-11
58/42	1.3913 - 1.3923	-36	-37	28/72	1.3611 - 1.3622	13	-10.5
57/43	1.3902 - 1.3912	-34	-36	27/73	1.3599 - 1.3610	14	-10
56/44	1.3891 - 1.3901	-32	-35	26/74	1.3587 - 1.3598	16	-9
55/45	1.3882 - 1.3890	-30	-34	25/75	1.3577 - 1.3586	16	-9
54/46	1.3873 - 1.3881	-28	-33	24/76	1.3566 - 1.3576	17	-8
53/47	1.3864 - 1.3872	-26	-32	23/77	1.3558 - 1.3565	18	-8
52/48	1.3855 - 1.3863	-24	-31	22/78	1.3548 - 1.3557	19	-7
51/49	1.3846 - 1.3854	-21	-29	21/79	1.3536 - 1.3547	20	-7
50/50	1.3835 - 1.3845	-19	-28	20/80	1.3527 - 1.3535	21	-6
49/51	1.3823 - 1.3834	-17	-27	19/81	1.3516 - 1.3526	22	-6
48/52	1.3811 - 1.3822	-15	-26	18/82	1.3508 - 1.3515	23	-5
47/53	1.3799 - 1.3810	-13	-25	17/83	1.3496 - 1.3507	23	-5
46/54	1.3787 - 1.3798	-11	-24	16/84	1.3486 - 1.3495	24	-5
45/55	1.3776 - 1.3786	-8	-22	15/85	1.3476 - 1.3485	24	-4
44/56	1.3768 - 1.3775	-7	-21.5	14/86	1.3466 - 1.3475	25	-4
43/57	1.3760 - 1.3767	-6	-21	13/87	1.3456 - 1.3465	26	-4
42/58	1.3752 - 1.3759	-5	-20.5	12/88	1.3446 - 1.3455	26	-3
41/59	1.3745 - 1.3751	-3	-19.5	11/89	1.3436 - 1.3445	27	-3
40/60	1.3735 - 1.3744	-2	-19	10/90	1.3426 - 1.3435	27	-3
39/61	1.3725 - 1.3734	0	-18	9/91	1.3416 - 1.3425	28	-2
38/62	1.3715 - 1.3724	1	-17	8/92	1.3406 - 1.3415	28	-2
37/63	1.3705 - 1.3714	2	-16.5	7/93	1.3396 - 1.3405	29	-2
36/64	1.3695 - 1.3704	3	-16	6/94	1.3385 - 1.3395	29	-2

9. Safewing MP I 1938 ECO

Brand Name: Safewing MP I 1938 ECO — Type I
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:

Max. concentrate % in mixture:	Max. Refractive Index No:	Max. Brix No:
65%	1.3988	39.4

2. Minimum LOUT (Lowest Operational Use Temperature): -26 °F (-32 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.423 - 1.426	pH	8.0 - 9.5
55/45 Dilution - Brix	33.2 - 34.8	Refractive Index	No Data	pH	7.0 - 8.5

Source: 2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
65/35	1.3973	-56	-49	35/65	1.3690	5	-15
64/36	1.3965	-53	-47	34/66	1.3679	7	-14
63/37	1.3957	-49	-45	33/67	1.3668	9	-13
62/38	1.3948	-47	-44	32/68	1.3658	9	-13
61/39	1.3940	-45	-43	31/69	1.3647	10	-12
60/40	1.3932	-42	-41	30/70	1.3636	12	-11
59/41	1.3922	-38	-39	29/71	1.3625	12	-11
58/42	1.3912	-36	-38	28/72	1.3614	14	-10
57/43	1.3901	-33	-36	27/73	1.3603	14	-10
56/44	1.3891	-29	-34	26/74	1.3592	16	-9
55/45	1.3881	-27	-33	25/75	1.3581	16	-9
54/46	1.3871	-26	-32	24/76	1.3570	18	-8
53/47	1.3861	-24	-31	23/77	1.3559	18	-8
52/48	1.3852	-22	-30	22/78	1.3548	19	-7
51/49	1.3842	-20	-29	21/79	1.3537	19	-7
50/50	1.3832	-17	-27	20/80	1.3526	21	-6
49/51	1.3822	-15	-26	19/81	1.3517	21	-6
48/52	1.3812	-13	-25	18/82	1.3508	23	-5
47/53	1.3802	-11	-24	17/83	1.3499	23	-5
46/54	1.3792	-9	-23	16/84	1.3490	23	-5
45/55	1.3782	-9	-23	15/85	1.3481	25	-4
44/56	1.3772	-8	-22	14/86	1.3470	25	-4
43/57	1.3762	-6	-21	13/87	1.3459	27	-3
42/58	1.3752	-4	-20	12/88	1.3448	27	-3
41/59	1.3742	-2	-19	11/89	1.3437	27	-3
40/60	1.3732	0	-18	10/90	1.3426	27	-3
39/61	1.3724	1	-17	9/91	1.3416	28	-2
38/62	1.3715	1	-17	8/92	1.3407	28	-2
37/63	1.3707	3	-16	7/93	1.3397	28	-2
36/64	1.3698	5	-15	6/94	1.3388	28	-2

10. Safewing MP I 1938 ECO (80)

Brand Name: Safewing MP I 1938 ECO (80) — Type I
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 71%
Max. Refractive Index No: 1.399
Max. Brix No: 39.75
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	48.25 - 49.50	Refractive Index	1.416 - 1.419	pH	8.0 - 9.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source: 2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3790	-22	-30
99/1				48/52	1.3780	-21	-29
98/2				47/53	1.3770	-21	-29
97/3				46/54	1.3770	-20	-29
96/4				45/55	1.3760	-19	-28
95/5				44/56	1.3750	-18	-28
94/6				43/57	1.3740	-18	-28
93/7				42/58	1.3730	-17	-27
92/8				41/59	1.3720	-16	-27
91/9				40/60	1.3710	-15	-26
90/10				39/61	1.3700	-15	-26
89/11				38/62	1.3690	-14	-25
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29	1.3980	-48	-44	20/80			
70/30	1.3970	-47	-44	19/81			
69/31	1.3960	-46	-43	18/82			
68/32	1.3950	-44	-42	17/83			
67/33	1.3940	-43	-42	16/84			
66/34	1.3940	-41	-41	15/85			
65/35	1.3930	-39	-39	14/86			
64/36	1.3920	-38	-39	13/87			
63/37	1.3910	-37	-38	12/88			
62/38	1.3900	-36	-38	11/89			
61/39	1.3890	-35	-37	10/90			
60/40	1.3890	-34	-37	9/91			
59/41	1.3880	-33	-36	8/92			
58/42	1.3870	-31	-35	7/93			
57/43	1.3860	-30	-34	6/94			
56/44	1.3850	-29	-34	5/95			
55/45	1.3840	-28	-33	4/96			
54/46	1.3830	-27	-33	3/97			
53/47	1.3820	-26	-32	2/98			
52/48	1.3820	-25	-32	1/99			
51/49	1.3810	-24	-31	0/100			
50/50	1.3800	-23	-31				

11. Safewing MP I 1938 ECO Premix

Brand Name: Safewing MP I 1938 ECO Premix — Type I
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 55%
Max. Refractive Index No: 1.384
Max. Brix No: 31.75
2. Minimum LOUT (Lowest Operational Use Temperature): 0 °F (-18 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	30.50 - 32.25	Refractive Index	1.382 - 1.385	pH	7.0 - 9.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source: 2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3790	-22	-30
99/1				48/52	1.3780	-21	-29
98/2				47/53	1.3770	-21	-29
97/3				46/54	1.3770	-20	-29
96/4				45/55	1.3760	-19	-28
95/5				44/56	1.3750	-18	-28
94/6				43/57	1.3740	-18	-28
93/7				42/58	1.3730	-17	-27
92/8				41/59	1.3720	-16	-27
91/9				40/60	1.3710	-15	-26
90/10				39/61	1.3700	-15	-26
89/11				38/62	1.3690	-14	-26
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29	1.3980	-48	-44	20/80			
70/30	1.3970	-47	-44	19/81			
69/31	1.3960	-46	-43	18/82			
68/32	1.3950	-44	-42	17/83			
67/33	1.3940	-43	-42	16/84			
66/33	1.3940	-41	-41	15/85			
65/35	1.3930	-39	-39	14/86			
64/36	1.3920	-38	-39	13/87			
63/37	1.3910	-37	-38	12/88			
62/38	1.3900	-36	-38	11/89			
61/39	1.3890	-35	-37	10/90			
60/40	1.3890	-34	-37	9/91			
59/41	1.3880	-33	-36	8/92			
58/42	1.3870	-31	-35	7/93			
57/43	1.3860	-30	-34	6/94			
56/44	1.3840	-29	-34	5/95			
55/45	1.3840	-28	-33	4/96			
54/46	1.3830	-27	-33	3/97			
53/47	1.3820	-26	-32	2/98			
52/48	1.3820	-25	-32	1/99			
51/49	1.3810	-24	-31	0/100			
50/50	1.3800	-23	-31				

12. Safewing MP I 1938 ECO Plus

Brand Name: Safewing MP I 1938 ECO Plus — Type I
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 71% — Max. Refractive Index No: 1.419 — Max. Brix No: -
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Colorless 5. Base: PG 6. Spec: AMS 1424/1
7. Field Test Acceptability:

Concentrate - Brix	48.1 - 49.5	Refractive Index	1.416 - 1.419	pH	8.0 - 9.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source: 2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3790	-22	-30
99/1				48/52	1.3780	-21	-29
98/2				47/53	1.3770	-21	-29
97/3				46/54	1.3770	-20	-29
96/4				45/55	1.3760	-19	-28
95/5				44/56	1.3750	-18	-28
94/6				43/57	1.3740	-18	-28
93/7				42/58	1.3730	-17	-27
92/8				41/59	1.3720	-16	-27
91/9				40/60	1.3710	-15	-26
90/10				39/61	1.3700	-15	-26
89/11				38/62	1.3690	-14	-26
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29	1.3980	-48	-44	20/80			
70/30	1.3970	-47	-44	19/81			
69/31	1.3960	-46	-43	18/82			
68/32	1.3950	-44	-42	17/83			
67/33	1.3940	-43	-42	16/84			
66/33	1.3940	-41	-41	15/85			
65/35	1.3930	-39	-39	14/86			
64/36	1.3920	-38	-39	13/87			
63/37	1.3910	-37	-38	12/88			
62/38	1.3900	-36	-38	11/89			
61/39	1.3890	-35	-37	10/90			
60/40	1.3890	-34	-37	9/91			
59/41	1.3880	-33	-36	8/92			
58/42	1.3870	-31	-35	7/93			
57/43	1.3860	-30	-34	6/94			
56/44	1.3840	-29	-34	5/95			
55/45	1.3840	-28	-33	4/96			
54/46	1.3830	-27	-33	3/97			
53/47	1.3820	-26	-32	2/98			
52/48	1.3820	-25	-32	1/99			
51/49	1.3810	-24	-31	0/100			
50/50	1.3800	-23	-31				

13. Safewing MP I LFD 88

Brand Name **Safewing MP I LFD 88** **Type I**
Manufacture **Clariant**

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:

Max. concentrate % in mixture:	Max. Refractive Index No:	Max. Brix No:
65%	1.3990	39.5

2. Minimum LOUT (Lowest Operational Use Temperature): Note: High-speed aerodynamics.
-27.4 °F (-33 °C)
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424/1
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.4230 - 1.4260	pH	7.1 - 8.1
55/45 Dilution - Brix	33.2 - 34.8	Refractive Index	1.3870 - 1.3900	pH	6.1 - 7.6
60/40 Dilution - Brix	35.9 - 37.5	Refractive Index	1.3920 - 1.3950	pH	6.3 - 7.8

Source: Clariant Corporation Product Sheet version 8.0, August 2019

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
				37/63	1.3705	3.2	-16
65/35	1.3975	-54.4	-48	36/64	1.3695	5.0	-15
64/36	1.3966	-50.8	-46	35/65	1.3684	5.0	-15
63/37	1.3957	-49.0	-45	34/66	1.3674	6.8	-14
62/38	1.3947	-45.4	-43	33/67	1.3664	8.6	-13
61/39	1.3938	-43.6	-42	32/68	1.3653	8.6	-13
60/40	1.3929	-40.0	-40	31/69	1.3643	10.4	-12
59/41	1.3920	-38.2	-39	30/70	1.3633	10.4	-12
58/42	1.3911	-34.6	-37	29/71	1.3622	12.2	-11
57/43	1.3901	-32.8	-36	28/72	1.3612	14.0	-10
56/44	1.3892	-31.0	-35	27/73	1.3601	14.0	-10
55/45	1.3883	-27.4	-33	26/74	1.3591	15.8	-9
54/46	1.3874	-23.8	-31	25/75	1.3581	15.8	-9
53/47	1.3864	-22.0	-30	24/76	1.3570	17.6	-8
52/48	1.3855	-18.4	-28	23/77	1.3560	19.4	-7
51/49	1.3845	-18.4	-28	22/78	1.3550	19.4	-7
50/50	1.3835	-16.6	-27	21/79	1.3539	21.2	-6
49/51	1.3825	-14.8	-26	20/80	1.3529	21.2	-6
48/52	1.3815	-13.0	-25	19/81	1.3519	23.0	-5
47/53	1.3805	-9.4	-23	18/82	1.3508	23.0	-5
46/54	1.3795	-9.4	-23	17/83	1.3498	23.0	-5
45/55	1.3786	-7.6	-22	16/84	1.3488	24.8	-4
44/56	1.3776	-5.8	-21	15/85	1.3478	24.8	-4
43/57	1.3766	-4.0	-20	14/86	1.3467	24.8	-4
42/58	1.3756	-2.2	-19	13/87	1.3457	26.6	-3
41/59	1.3746	-0.4	-18	12/88	1.3446	26.6	-3
40/60	1.3736	-0.4	-18	11/89	1.3436	26.6	-3
39/61	1.3726	1.4	-17	10/90	1.3426	26.6	-3
38/62	1.3715	3.2	-16	09/91	1.3415	26.6	-3

14. Safewing MP | LDF 80

Brand Name **Safewing MP I LFD 80** **Type I**
Manufacturer **Clariant**

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:

Max. concentrate % in mixture:	Max. Refractive Index No:	Max. Brix No:
71%	1.4	No Data

2. Minimum LOUT (Lowest Operational Use Temperature): Note: High-speed aerodynamics.
-27.4 °F **(-33 °C)**
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: **Orange** 5. Base: **PG** 6. Spec: **AMS 1424/1**
7. Field Test Acceptability:

Concentrate - Brix	No Data	Refractive Index	1.416 - 1.420	pH	7.0 - 8.0
55/45 Dilution - Brix	No Data	Refractive Index	1.384	pH	5.5 - 98.0

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
71/29	1.397	-54	-48	35/65	1.365	10	-12
70/30	1.396	-53	-47	34/66	1.364	10	-12
69/31	1.395	-49	-45	33/67	1.363	12	-11
68/32	1.395	-47	-44	32/68	1.362	12	-11
67/33	1.394	-44	-42	31/69	1.362	14	-10
66/34	1.393	-42	-41	30/70	1.361	14	-10
65/35	1.392	-38	-39	29/71	1.360	16	-9
64/36	1.391	-36	-38	28/72	1.359	18	-8
63/37	1.391	-35	-37	27/73	1.358	18	-8
62/38	1.390	-31	-35	26/74	1.357	18	-8
61/39	1.389	-29	-34	25/75	1.356	19	-7
60/40	1.388	-27	-33	24/76	1.355	19	-7
59/41	1.387	-26	-32	23/77	1.354	21	-6
58/42	1.386	-24	-31	22/78	1.353	21	-6
57/43	1.385	-22	-30	21/79	1.352	23	-5
56/44	1.384	-20	-29	20/80	1.351	23	-5
55/45	1.384	-18	-28	19/81	1.350	23	-5
54/46	1.383	-17	-27	18/82	1.349	25	-4
53/47	1.382	-15	-26	17/83	1.348	25	-4
52/48	1.381	-13	-25	16/84	1.348	25	-4
51/49	1.380	-11	-24	15/85	1.347	27	-3
50/50	1.379	-9	-23	14/86	1.346	27	-3
49/51	1.378	-8	-22	13/87	1.345	27	-3
48/52	1.377	-6	-21	12/88	1.344	27	-3
47/53	1.376	-4	-20	11/89	1.343	27	-3
46/54	1.376	-20	-29	10/90	1.342	28	-2
45/55	1.375	-20	-29	9/91	1.341	28	-2
44/56	1.374	0	-18	8/92	1.340	28	-2
43/57	1.373	1	-17	7/93	1.339	28	-2
42/58	1.372	1	-17	6/94	1.338	30	-1
41/59	1.371	3	-16	5/95	1.337	30	-1
40/60	1.370	5	-15	4/96	1.337	30	-1
39/61	1.369	5	-15	3/97	1.336	30	-1
38/62	1.368	7	-14	2/98	1.335	32	0
37/63	1.367	9	-13	1/99	1.334	32	0
36/64	1.366	9	-13				

15. Polar Plus

Brand Name Polar Plus Type I
Manufacturer Cryotech Deicing Technology

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 63%
Max. Refractive Index No: 1.398
Max. Brix No: 39.1
2. Minimum LOUT (Lowest Operational Use Temperature): -25 °F (-32 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.4230 - 1.4260	pH	8.3 - 9.3
50/50 Dilution - Brix	31.6 - 32.1	Refractive Index	1.383 - 1.386	pH	6.5 - 9.3
55/45 Dilution - Brix	33.2 - 35.0	Refractive Index	1.387 - 1.390	pH	6.5 - 9.3

Source:Cryotech Deicng Technology (Lacey.Aschbrenner@cryotech.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3820	-15	-26
99/1				48/52	1.3810	-13	-25
98/2				47/53	1.3800	-11	-24
97/3				46/54	1.3790	-9	-23
96/4				45/55	1.3790	-8	-22
95/5				44/56	1.3770	-6	-21
94/6				43/57	1.3760	-4	-20
93/7				42/58	1.3750	-2	-19
92/8				41/59	1.3740	-1	-18
91/9				40/60	1.3740	1	-17
90/10				39/61	1.3720	2	-16
89/11				38/62	1.3710	4	-16
88/12				37/63	1.3700	5	-15
87/13				36/64	1.3690	7	-14
86/14				35/65	1.3690	8	-13
85/15				34/66	1.3670	9	-13
84/16				33/67	1.3660	10	-12
83/17				32/68	1.3650	11	-12
82/18				31/69	1.3640	12	-11
81/19				30/70	1.3630	13	-11
80/20				29/71	1.3620	14	-10
79/21				28/72	1.3610	15	-10
78/22				27/73	1.3600	16	-9
77/23				26/74	1.3580	16	-9
76/24				25/75	1.3580	17	-8
75/25				24/76	1.3570	18	-8
74/26				23/77	1.3560	18	-8
73/27				22/78	1.3550	19	-7
72/28				21/79	1.3540	19	-7
71/29				20/80	1.3530	20	-7
70/30	1.4030	-60	-51	19/81	1.3520	20	-7
69/31	1.4020	-58	-50	18/82	1.3510	21	-6
68/32	1.4010	-56	-49	17/83	1.3500	21	-6
67/33	1.4000	-54	-48	16/84	1.3490	21	-6
66/33	1.3990	-52	-47	15/85	1.3480	22	-6
65/35	1.3980	-50	-46	14/86	1.3470	22	-6
64/36	1.3970	-48	-44	13/87	1.3460	22	-5
63/37	1.3960	-46	-43	12/88	1.3450	23	-5
62/38	1.3950	-44	-42	11/89	1.3440	23	-5
61/39	1.3940	-41	-41	10/90	1.3430	23	-5
60/40	1.3930	-39	-40	9/91	1.3420	24	-5
59/41	1.3920	-37	-38	8/92	1.3410	24	-4
58/42	1.3910	-35	-37	7/93	1.3400	25	-4
57/43	1.3900	-33	-36	6/94	1.3390	25	-4
56/44	1.3890	-30	-35	5/95	1.3800	26	-4
55/45	1.3880	-28	-33	4/96	1.3370	26	-3
54/46	1.3870	-26	-32	3/97	1.3360	27	-3
53/47	1.3860	-24	-31	2/98	1.3350	28	-3
52/48	1.3850	-22	-30	1/99	1.3340	28	-2
51/49	1.3840	-19	-29	0/100	1.3330	32	0
50/50	1.3840	-17	-27				

16. Polar Plus LT

Brand Name: Polar Plus LT — Type I
Manufacturer: Cryotech Deicing Technology

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 63%
Max. Refractive Index No: 1.398
Max. Brix No: 39.1
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.4230 - 1.4260	pH	8.2 - 9.2
50/50 Dilution - Brix	31.6 - 32.1	Refractive Index	1.383 - 1.386	pH	6.5 - 9.2
55/45 Dilution - Brix	33.2 - 35.0	Refractive Index	1.387 - 1.390	pH	6.5 - 9.2

Source:Cryotech Deicng Technology (Lacey.Aschbrenner@cryotech.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.3820	-15	-26
99/1				48/52	1.3810	-13	-25
98/2				47/53	1.3800	-11	-24
97/3				46/54	1.3790	-9	-23
96/4				45/55	1.3790	-8	-22
95/5				44/56	1.3770	-6	-21
94/6				43/57	1.3760	-4	-20
93/7				42/58	1.3750	-2	-19
92/8				41/59	1.3740	-1	-18
91/9				40/60	1.3740	1	-17
90/10				39/61	1.3720	2	-16
89/11				38/62	1.3710	4	-16
88/12				37/63	1.3700	5	-15
87/13				36/64	1.3690	7	-14
86/14				35/65	1.3690	8	-13
85/15				34/66	1.3670	9	-13
84/16				33/67	1.3660	10	-12
83/17				32/68	1.3650	11	-12
82/18				31/69	1.3640	12	-11
81/19				30/70	1.3630	13	-11
80/20				29/71	1.3620	14	-10
79/21				28/72	1.3610	15	-10
78/22				27/73	1.3600	16	-9
77/23				26/74	1.3590	16	-9
76/24				25/75	1.3580	17	-8
75/25				24/76	1.3570	18	-8
74/26				23/77	1.3560	18	-8
73/27				22/78	1.3550	19	-7
72/28				21/79	1.3540	19	-7
71/29				20/80	1.3530	20	-7
70/30	1.4030	-60	-51	19/81	1.3520	20	-7
69/31	1.4020	-58	-50	18/82	1.3510	21	-6
68/32	1.4010	-56	-49	17/83	1.3500	21	-6
67/33	1.4000	-54	-48	16/84	1.3490	21	-6
66/33	1.3990	-52	-47	15/85	1.3480	22	-6
65/35	1.3980	-50	-46	14/86	1.3470	22	-6
64/36	1.3970	-48	-44	13/87	1.3460	22	-5
63/37	1.3960	-46	-43	12/88	1.3450	23	-5
62/38	1.3950	-44	-42	11/89	1.3440	23	-5
61/39	1.3940	-41	-41	10/90	1.3430	23	-5
60/40	1.3930	-39	-40	9/91	1.3420	24	-5
59/41	1.3920	-37	-38	8/92	1.3410	24	-4
58/42	1.3910	-35	-37	7/93	1.3400	25	-4
57/43	1.3900	-33	-36	6/94	1.3390	25	-4
56/44	1.3890	-30	-35	5/95	1.3380	26	-4
55/45	1.3880	-28	-33	4/96	1.3370	26	-3
54/46	1.3870	-26	-32	3/97	1.3360	27	-3
53/47	1.3860	-24	-31	2/98	1.3350	28	-3
52/48	1.3850	-22	-30	1/99	1.3340	28	-2
51/49	1.3840	-19	-29	0/100	1.3330	32	0
50/50	1.3840	-17	-27				

17. Polar Plus LT (80)

Brand Name: Polar Plus LT (80) — Type I
Manufacturer: Cryotech Deicing Technology

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70%
Max. Refractive Index No: 1.3955
Max. Brix No: 37.8
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	48.3 - 49.8	Refractive Index	1.4165 - 1.4195	pH	8.0 - 9.2
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source:Cryotech Deicng Technology (Lacey.Aschbrenner@cryotech.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.377	-9	-23
99/1				48/52	1.376	-7	-22
98/2				47/53	1.375	-6	-21
97/3				46/54	1.375	-4	-20
96/4				45/55	1.374	-3	-19
95/5				44/56	1.373	-2	-19
94/6				43/57	1.372	0	-18
93/7				42/58	1.381	1	-17
92/8				41/59	1.370	2	-17
91/9				40/60	1.369	3	-16
90/10				39/61	1.368	4	-15
89/11				38/62	1.367	6	-15
88/12				37/63	1.366	7	-14
87/13				36/64	1.365	8	-13
86/14				35/65	1.364	9	-13
85/15				34/66	1.364	10	-12
84/16				33/67	1.363	11	-12
83/17				32/68	1.362	12	-11
82/18				31/69	1.361	13	-10
81/19				30/70	1.360	14	-10
80/20				29/71	1.359	15	-9
79/21				28/72	1.358	16	-9
78/22				27/73	1.357	17	-8
77/23				26/74	1.356	18	-8
76/24				25/75	1.355	19	-7
75/25				24/76	1.354	20	-7
74/26				23/77	1.353	21	-6
73/27				22/78	1.353	22	-6
72/28				21/79	1.352	22	-5
71/29				20/80	1.351	23	-5
70/30	1.396	-50	-46	19/81	1.350	24	-5
69/31	1.395	-47	-44	18/82	1.349	25	-4
68/32	1.394	-45	-43	17/83	1.348	25	-4
67/33	1.393	-42	-41	16/84	1.347	26	-3
66/33	1.392	-40	-40	15/85	1.346	27	-3
65/35	1.391	-38	-39	14/86	1.345	27	-3
64/36	1.390	-35	-37	13/87	1.344	28	-2
63/37	1.896	-33	-36	12/88	1.354	28	-2
62/38	1.389	-31	-35	11/89	1.343	29	-2
61/39	1.388	-29	-34	10/90	1.342	29	-1
60/40	1.387	-27	-33	9/91	1.341	30	-1
59/41	1.386	-25	-32	8/92	1.340	30	-1
58/42	1.385	-23	-31	7/93	1.339	31	-1
57/43	1.384	-21	-30	6/94	1.338	31	-1
56/44	1.384	-20	-29	5/95	1.337	31	0
55/45	1.383	-18	-28	4/96	1.336	32	0
54/46	1.382	-16	-27	3/97	1.336	32	0
53/47	1.381	-15	-26	2/98	1.335	32	0
52/48	1.380	-13	-25	1/99	1.334	32	0
51/49	1.338	-12	-24	0/100	1.333	32	0
50/50	1.378	-10	-23				

18. Polar Plus (80)

Brand Name Polar Plus (80) Type I
Manufacturer Cryotech Deicing Technology

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70%
Max. Refractive Index No: 1.3955
Max. Brix No: 37.8
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	48.3 - 49.8	Refractive Index	1.4165 - 1.4195	pH	8.0 - 9.7
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source:Cryotech Deicng Technology (Lacey.Aschbrenner@cryotech.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	1.377	-9	-23
99/1				48/52	1.376	-7	-22
98/2				47/53	1.375	-6	-21
97/3				46/54	1.375	-4	-20
96/4				45/55	1.374	-3	-19
95/5				44/56	1.373	-2	-19
94/6				43/57	1.372	0	-18
93/7				42/58	1.381	1	-17
92/8				41/59	1.370	2	-17
91/9				40/60	1.369	3	-16
90/10				39/61	1.368	4	-15
89/11				38/62	1.367	6	-15
88/12				37/63	1.366	7	-14
87/13				36/64	1.365	8	-13
86/14				35/65	1.364	9	-13
85/15				34/66	1.364	10	-12
84/16				33/67	1.363	11	-12
83/17				32/68	1.362	12	-11
82/18				31/69	1.361	13	-10
81/19				30/70	1.360	14	-10
80/20				29/71	1.359	15	-9
79/21				28/72	1.358	16	-9
78/22				27/73	1.357	17	-8
77/23				26/74	1.356	18	-8
76/24				25/75	1.355	19	-7
75/25				24/76	1.354	20	-7
74/26				23/77	1.353	21	-6
73/27				22/78	1.353	22	-6
72/28				21/79	1.352	22	-5
71/29				20/80	1.351	23	-5
70/30	1.396	-50	-46	19/81	1.350	24	-5
69/31	1.395	-47	-44	18/82	1.349	25	-4
68/32	1.394	-45	-43	17/83	1.348	25	-4
67/33	1.393	-42	-41	16/84	1.347	26	-3
66/33	1.392	-40	-40	15/85	1.346	27	-3
65/35	1.391	-38	-39	14/86	1.345	27	-3
64/36	1.390	-35	-37	13/87	1.344	28	-2
63/37	1.896	-33	-36	12/88	1.354	28	-2
62/38	1.389	-31	-35	11/89	1.343	29	-2
61/39	1.388	-29	-34	10/90	1.342	29	-1
60/40	1.387	-27	-33	9/91	1.341	30	-1
59/41	1.386	-25	-32	8/92	1.340	30	-1
58/42	1.385	-23	-31	7/93	1.339	31	-1
57/43	1.384	-21	-30	6/94	1.338	31	-1
56/44	1.384	-20	-29	5/95	1.337	31	0
55/45	1.383	-18	-28	4/96	1.336	32	0
54/46	1.382	-16	-27	3/97	1.336	32	0
53/47	1.381	-15	-26	2/98	1.335	32	0
52/48	1.380	-13	-25	1/99	1.334	32	0
51/49	1.338	-12	-24	0/100	1.333	32	0
50/50	1.378	-10	-23				

19. SafeTemp ES Plus

Brand Name: SafeTemp ES Plus — Type I
Manufacturer: Inland Technologies

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 65% — Max. Refractive Index No: 1.3983 — Max. Brix No: 38
2. Minimum LOUT (Lowest Operational Use Temperature): -20 °F (-29 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424K
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.4230 - 1.4260	pH	7.0 - 8.0
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source:Inland Technologies (bmccreary@inlandgroup.ca)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/1	1.4245	Do Not Use		49/51	1.3815	-15	-26
99/1				48/52	1.3807	-13	-25
98/2				47/53	1.3799	-11	-24
97/3				46/54	1.3791	-9	-23
96/4				45/55	1.3783	-8	-22
95/5				44/56	1.3775	-6	-21
94/6				43/57	1.3767	-5	-21
93/7				42/58	1.3759	-3	-19
92/8				41/59	1.3751	-2	-19
91/9				40/60	1.3731	0	-18
90/10	1.4171	-38	-39	39/61	1.3711	2	-17
89/11				38/62	1.3703	3	-16
88/12				37/63	1.3695	5	-15
87/13				36/64	1.3686	6	-14
86/14				35/65	1.3677	7	-13
85/15				34/66	1.3668	8	-13
84/16				33/67	1.3659	9	-13
83/17				32/68	1.3650	10	-12
82/18				31/69	1.3641	11	-12
81/19				30/70	1.3621	12	-11
80/20	1.4093	-38	-39	29/71	1.3603	12	-11
79/21				28/72	1.3596	13	-11
78/22				27/73	1.3590	13	-11
77/23				26/74	1.3583	14	-10
76/24				25/75	1.3576	14	-10
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3526	19	-7
70/30	1.4011	-45	-43	19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85	1.3474	24	-4
65/35	1.3968	-43	-42	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90	1.3422	28	-2
60/40	1.3926	-40	-40	9/91			
59/41	1.3908	-39	-39	8/92			
58/42	1.3902	-38	-39	7/93			
57/43	1.3896	-36	-38	6/94			
56/44	1.3889	-34	-37	5/95			
55/45	1.3882	-32	-36	4/96			
54/46	1.3875	-29	-34	3/97			
53/47	1.3868	-26	-32	2/98			
52/48	1.3861	-23	-31	1/99			
51/49	1.3854	-20	-29	0/100			
50/50	1.3835	-17	-27				

20. UCAR ADF Concentrate (EG)

Brand Name UCAR ADF Concentrate (EG) Type I
Manufacturer Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 75%
Max. Refractive Index No: 1.4038
Max. Brix No: 42
2. Minimum LOUT (Lowest Operational Use Temperature): -49 °F (-45 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: EG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	50.5 - 53.5	Refractive Index	1.421 - 1.426	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/1	1.3954-1.4036	-18	-28	58.9 / 41.1	1.3902	-51	-46
99/1	Do Not Spray			58.2 / 41.8	1.3894	-49	-45
98/2				57.4 / 42.6	1.3887	-47	-45
97/3				56.7 / 43.3	1.3879	-45	-44
96/4				55.9 / 44.1	1.3872	-44	-42
95/5				55.1 / 44.9	1.3867	-42	-41
94/6				54.3 / 45.7	1.3858	-40	-40
93/7				53.5 / 46.5	1.385	-38	-39
92/8				52.7 / 47.3	1.384	-36	-38
91/9				51.9 / 48.1	1.384	-35	-37
90/10				51.1 / 48.9	1.383	-33	-36
89/11				50.3 / 49.7	1.382	-31	-35
88/12				49.4 / 50.6	1.381	-29	-34
87/13				48.6 / 51.4	1.381	-27	-33
86/14				47.7 / 52.3	1.380	-26	-32
85/15				46.9 / 53.1	1.379	-24	-31
84/16				46.0 / 54.0	1.378	-22	-30
83/17				45.1 / 54.9	1.377	-20	-29
82/18				44.2 / 55.8	1.376	-18	-28
81/19				43.3 / 56.7	1.375	-17	-27
80/20				42.4 / 57.6	1.375	-15	-26
79/21				41.5 / 58.5	1.374	-13	-25
78/22				40.5 / 59.5	1.373	-11	-24
77/23				39.5 / 60.5	1.372	-9	-23
76/24				38.5 / 61.5	1.371	-8	-22
75/25	1.3952 - 1.4032	below -67	below -55	37.4 / 62.6	1.370	-6	-21
74/26	1.3952 - 1.4032	below -67	below -55	36.3 / 63.7	1.369	-4	-20
73/27	1.3952 - 1.4032	below -67	below -55	35.2 / 64.8	1.368	-2	-19
72/28	1.3952 - 1.4032	below -67	below -55	34.0 / 66.0	1.366	0	-18
71/29	1.3952 - 1.4032	below -67	below -55	32.8 / 67.2	1.365	1	-17
70/30	1.3952 - 1.4032	below -67	below -55	31.5 / 68.5	1.364	3	-16
69/31	1.3952 - 1.4032	below -67	below -55	30.2 / 69.8	1.363	5	-15
68/32	1.3952 - 1.4032	below -67	below -55	28.8 / 71.2	1.361	7	-14
67/33	1.3952 - 1.4032	below -67	below -55	27.4 / 72.6	1.360	9	-13
66/33	1.3952 - 1.4032	below -67	below -55	25.9 / 74.1	1.359	10	-12
64.6 / 35.4	1.3952	-67	-55	24.3 / 75.7	1.357	12	-11
64.1 / 35.9	1.3949	-65	-54	22.6 / 77.4	1.355	14	-10
63.5 / 36.5	1.3943	-63	-53	20.8 / 79.2	1.354	16	-9
63.0 / 37.0	1.3937	-62	-52	19.0 / 81.0	1.352	18	-8
62.3 / 37.7	1.3931	-60	-51	17.0 / 83.0	1.350	19	-7
61.7 / 38.3	1.3926	-58	-50	15.0 / 85.0	1.348	21	-6
61.0 / 39.0	1.3920	-56	-49	12.8 / 87.2	1.346	23	-5
60.3 / 39.7	1.3915	-54	-48	0 / 100	1.333	32	0
59.6 / 40.4	1.3907	-53	-47				

21. UCAR ADF XL54

Brand Name UCAR ADF XL 54 Type I
Manufacturer Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: N/A (RTU) Max. Refractive Index No: 1.396 Max. Brix No: 36
2. Minimum LOUT (Lowest Operational Use Temperature): -27 °F (-33 °C) Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: EG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	32.0 - 36	Refractive Index	1.385 - 1.396	pH	7.0 - 8.0
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
Ready to Use - Prediluted ADF				Ready to Use - Prediluted ADF			

22. UCAR PG ADF Concentrate

Brand Name: UCAR PG ADF Concentrate — Type I
Manufacturer: Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 65%
Max. Refractive Index No: 1.3975
Max. Brix No: 39
2. Minimum LOUT (Lowest Operational Use Temperature): -25 °F (-32 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	50.5 - 53.5	Refractive Index	1.421 - 1.4275	pH	8.0 - 9.0
50/50 Dilution - Brix	30.0 - 33.0	Refractive Index	1.3811 - 1.3865	pH	7.5 - 8.5
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/1	1.424	Does not Freeze		59/41	1.3922	-44	-42
99/1	Do Not Spray			58/42	1.3913	-40	-40
98/2	Do Not Spray			57/43	1.3904	-38	-39
97/3	Do Not Spray			56/44	1.3894	-35	-37
96/4	Do Not Spray			55/45	1.3885	-33	-36
95/5	Do Not Spray			54/46	1.3876	-29	-34
94/6	Do Not Spray			53/47	1.3865	-27	-33
93/7	Do Not Spray			52/48	1.3856	-24	-31
92/8	Do Not Spray			51/49	1.3847	-22	-30
91/9	Do Not Spray			50/50	1.3838	-20	-29
90/10	Do Not Spray			49 / 51	1.383	-18	-28
89/11	Do Not Spray			48 / 52	1.382	-15	-26
88/12	Do Not Spray			47 / 53	1.381	-13	-25
87/13	Do Not Spray			46 / 54	1.380	-11	-24
86/14	Do Not Spray			45 / 55	1.379	-9	-23
85/15	Do Not Spray			44 / 56	1.378	-8	-22
84/16	Do Not Spray			43 / 57	1.377	-6	-21
83/17	Do Not Spray			42 / 58	1.376	-4	-20
82/18	Do Not Spray			41 / 59	1.375	-2	-19
81/19	Do Not Spray			40 / 60	1.374	0	-18
80/20	Do Not Spray			39 / 61	1.373	1	-17
79/21	Do Not Spray			37 / 63	1.371	3	-16
78/22	Do Not Spray			36 / 64	1.370	5	-15
77/23	Do Not Spray			35 / 65	1.369	7	-14
76/24	Do Not Spray			33 / 67	1.367	9	-13
75/25	Do Not Spray			32 / 68	1.366	10	-12
74/26	Do Not Spray			30 / 70	1.364	12	-11
73/27	Do Not Spray			28 / 72	1.362	14	-10
72/28	Do Not Spray			27 / 73	1.361	16	-9
71/29	Do Not Spray			25 / 75	1.359	18	-8
70/30	Do Not Spray			20 / 80	1.354	21	-6
69/31	Do Not Spray			15 / 85	1.348	25	-4
68/32	Do Not Spray			10 / 90	1.343	27	-3
67/33	Do Not Spray			5 / 95	1.338	30	-1
66/33	Do Not Spray			0 / 100	1.333	32	0
65/35	1.3978	-63	-53				
64/36	1.3968	-60	-51				
63/37	1.3958	-56	-49				
62/38	1.3950	-53	-47				
61/39	1.3941	-49	-45				
60/40	1.3931	-47	-44				

23. UCAR PG ADF Dilute 55/45

Brand Name UCAR PG ADF Dilute 55/45 Type I
Manufacturer Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: N/A (RTU)
Max. Refractive Index No: 1.3929
Max. Brix No: 36.5
2. Minimum LOUT (Lowest Operational Use Temperature): -13 °F (-25 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	32.5 - 36.5	Refractive Index	1.3856 - 1.3929	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
Ready to Use - Prediluted ADF				Ready to Use - Prediluted ADF			

24. SafeTemp ES Plus

Brand Name: SafeTemp ES Plus — Type I
Manufacturer: HOC Industries

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 65% — Max. Refractive Index No: 1.3983 — Max. Brix No: 38
2. Minimum LOUT (Lowest Operational Use Temperature): -20 °F (-29 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424K
7. Field Test Acceptability:

Concentrate - Brix	51.4 - 52.8	Refractive Index	1.4230 - 1.4260	pH	7.0 - 8.0
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source:Inland Technologies (bmccreary@inlandgroup.ca)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/1	1.4245	Do Not Use		49/51	1.3815	-15	-26
99/1				48/52	1.3807	-13	-25
98/2				47/53	1.3799	-11	-24
97/3				46/54	1.3791	-9	-23
96/4				45/55	1.3783	-8	-22
95/5				44/56	1.3775	-6	-21
94/6				43/57	1.3767	-5	-21
93/7				42/58	1.3759	-3	-19
92/8				41/59	1.3751	-2	-19
91/9				40/60	1.3731	0	-18
90/10	1.4171	-38	-39	39/61	1.3711	2	-17
89/11				38/62	1.3703	3	-16
88/12				37/63	1.3695	5	-15
87/13				36/64	1.3686	6	-14
86/14				35/65	1.3677	7	-13
85/15				34/66	1.3668	8	-13
84/16				33/67	1.3659	9	-13
83/17				32/68	1.3650	10	-12
82/18				31/69	1.3641	11	-12
81/19				30/70	1.3621	12	-11
80/20	1.4093	-38	-39	29/71	1.3603	12	-11
79/21				28/72	1.3596	13	-11
78/22				27/73	1.3590	13	-11
77/23				26/74	1.3583	14	-10
76/24				25/75	1.3576	14	-10
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3526	19	-7
70/30	1.4011	-45	-43	19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85	1.3474	24	-4
65/35	1.3968	-43	-42	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90	1.3422	28	-2
60/40	1.3926	-40	-40	9/91			
59/41	1.3908	-39	-39	8/92			
58/42	1.3902	-38	-39	7/93			
57/43	1.3896	-36	-38	6/94			
56/44	1.3889	-34	-37	5/95			
55/45	1.3882	-32	-36	4/96			
54/46	1.3875	-29	-34	3/97			
53/47	1.3868	-26	-32	2/98			
52/48	1.3861	-23	-31	1/99			
51/49	1.3854	-20	-29	0/100			
50/50	1.3835	-17	-27				

25. Inland ADF Concentrate

Brand Name: Inland ADF Concentrate — Type I
Manufacturer: Inland Technologies

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 65%
Max. Refractive Index No: 1.426
Max. Brix No: 53.5
2. Minimum LOUT (Lowest Operational Use Temperature): -44.5 °F (-42.5 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	50.5 - 53.5	Refractive Index	1.421 - 1.426	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Source:Inland Technologies (bmccreary@inlandgroup.ca)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Brix Index (20°C/68°F) (± 0.2)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Brix Index (20°C/68°F) (± 0.2)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51	30.0	-29	-34
99/1				48/52	29.4	-26	-32
98/2				47/53	28.8	-24	-31
97/3				46/54	28.3	-22	-30
96/4				45/55	27.8	-20	-29
95/5				44/56	27.3	-18	-28
94/6				43/57	26.8	-17	-27
93/7				42/58	26.1	-15	-26
92/8				41/59	25.5	-12	-25
91/9				40/60	24.9	-10	-24
90/10				39/61	24.4	-9	-23
89/11				38/62	23.8	-6	-21
88/12				37/63	23.3	-6	-21
87/13				36/64	22.9	-4	-20
86/14				35/65	22.2	-2	-19
85/15				34/66	21.5	0	-18
84/16				33/67	20.8	1	-17
83/17				32/68	20.3	3	-16
82/18				31/69	19.8	4	-16
81/19				30/70	19.3	5	-15
80/20				29/71	18.5	7	-14
79/21				28/72	17.9	8	-13
78/22				27/73	17.3	9	-13
77/23				26/74	16.7	10	-12
76/24				25/75	16.3	11	-12
75/25				24/76	15.7	12	-11
74/26				23/77	14.7	14	-10
73/27				22/78	14.2	15	-10
72/28				21/79	13.6	16	-9
71/29				20/80	13.0	17	-9
70/30				19/81	12.4	18	-8
69/31				18/82	11.8	19	-8
68/32				17/83	11.2	19	-7
67/33				16/84	10.3	20	-7
66/34				15/85	9.9	21	-6
65/35	37.8	-67	-55	14/86	9.2	22	-6
64/36	37.5	-65	-54	13/87	8.5	23	-5
63/37	36.9	-62	-52	12/88			
62/38	36.5	-60	-51	11/89			
61/39	36.0	-56	-49	10/90			
60/40	35.5	-54	-48	9/91			
59/41	35.0	-51	-46	8/92			
58/42	34.6	-49	-45	7/93			
57/43	34.0	-46	-43	6/94			
56/44	33.4	-44	-42	5/95			
55/45	33.1	-42	-41	4/96			
54/46	32.5	-40	-40	3/97			
53/47	32.0	-37	-38	2/98			
52/48	31.4	-35	-37	1/99			
51/49	31.0	-33	-36	0/100			
50/50	30.5	-31	-35				

26. DF Plus

Brand Name: DF Plus — Type I
Manufacturer: Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 69%
Max. Refractive Index No: 1.396
Max. Brix No: 38.25
2. Minimum LOUT (Lowest Operational Use Temperature): -25 °F (-32 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Clear or Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	48.75 - 50.00	Refractive Index	1.4175 - 1.4205	pH	7.0 - 10
69/31 Dilution - Brix	38.25	Refractive Index	1.396	pH	min 6.0
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.4190	Does Not Freeze		49/51	1.3786	-5	-21
99/1	1.4182			48/52	1.3777	-4	-20
98/2	1.4175			47/53	1.3766	-2	-19
97/3	1.4169			46/54	1.3757	-1	-18
96/4	1.4164			45/55	1.3746	0	-18
95/5	1.4157			44/56	1.3738	1	-17
94/6	1.4150			43/57	1.3730	2	-17
93/7	1.4144			42/58	1.3722	4	-16
92/8	1.4137			41/59	1.3712	5	-15
91/9	1.1310			40/60	1.3704	5	-15
90/10	1.4125			39/61	1.3694	7	-14
89/11	1.4117			38/62	1.3684	8	-14
88/12	1.4110			37/63	1.3675	9	-13
87/13	1.4103			36/64	1.3665	10	-13
86/14	1.4096			35/65	1.3656	10	-12
85/15	1.4087			34/66	1.3646	11	-12
84/16	1.4080			33/67	1.3637	12	-11
83/17	1.4073			32/68	1.3629	13	-11
82/18	1.4065			31/69	1.3620	14	-10
81/19	1.4058			30/70	1.3610	14	-10
80/20	1.4050			29/71	1.3600	15	-9
79/21	1.4044			28/72	1.3590	16	-9
78/22	1.4035			27/73	1.3582	17	-9
77/23	1.4027			26/74	1.3573	17	-8
76/24	1.4019			25/75	1.3563	18	-8
75/25	1.1014	-72	-58	24/76	1.3554	19	-7
74/26	1.4004	-65	-54	23/77	1.3545	20	-7
73/27	1.4000	-60	-51	22/78	1.3536	20	-7
72/28	1.3988	-55	-49	21/79	1.3525	21	-6
71/29	1.3980	-54	-48	20/80	1.3517	22	-6
70/30	1.3973	-47	-44	19/81	1.3507	22	-6
69/31	1.3964	-44	-42	18/82	1.3498	23	-5
68/32	1.3955	-41	-41	17/83	1.3488	23	-5
67/33	1.3947	-38	-39	16/84	1.3480	24	-5
66/34	1.3939	-36	-38	15/85	1.3472	24	-4
65/35	1.3931	-33	-36	14/86	1.3461	25	-4
64/36	1.3923	-31	-35	13/87	1.3450	26	-4
63/37	1.3914	-28	-34	12/88	1.3442	26	-3
62/38	1.3906	-26	-32	11/89	1.3433	27	-3
61/39	1.3897	-24	-31	10/90	1.3423	27	-3
60/40	1.3887	-22	-30	9/91	1.3414	28	-2
59/41	1.3878	-20	-29	8/92	1.3405	28	-2
58/42	1.3870	-19	-28	7/93	1.3395	29	-2
57/43	1.3862	-17	-27	6/94	1.3386	29	-2
56/44	1.3852	-15	-26	5/95	1.3377	30	-1
55/45	1.3843	-14	-25	4/96	1.3368	30	-1
54/46	1.3833	-12	-24	3/97	1.3358	31	-1
53/47	1.3824	-11	-24	2/98	1.3350	31	-1
52/48	1.3815	-9	-23	1/99	1.3340	32	0
51/49	1.3805	-8	-22	0/100		32	0
50/50	1.3795	-7	-22				

27. DF Plus (80)

Brand Name: DF Plus (80) — Type I
Manufacturer: Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 69% — Max. Refractive Index No: 1.396 — Max. Brix No: 38.25
2. Minimum LOUT (Lowest Operational Use Temperature): -24.7 °F (-31.5 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Clear or Orange — 5. Base: PG — 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	48.75 - 50.00	Refractive Index	1.4175 - 1.4205	pH	7.0 - 10.0
69/31 Dilution - Brix	38.25	Refractive Index	1.396	pH	min 6.0
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.4190	Does Not Freeze		49/51	1.3786	-5	-21
99/1	1.4182			48/52	1.3777	-4	-20
98/2	1.4175			47/53	1.3766	-2	-19
97/3	1.4169			46/54	1.3757	-1	-18
96/4	1.4164			45/55	1.3746	0	-18
95/5	1.4157			44/56	1.3738	1	-17
94/6	1.4150			43/57	1.3730	2	-17
93/7	1.4144			42/58	1.3722	4	-16
92/8	1.4137			41/59	1.3712	5	-15
91/9	1.4130			40/60	1.3704	5	-15
90/10	1.4125			39/61	1.3694	7	-14
89/11	1.4117			38/62	1.3684	8	-14
88/12	1.4110			37/63	1.3675	9	-13
87/13	1.4103			36/64	1.3665	10	-13
86/14	1.4096			35/65	1.3656	10	-12
85/15	1.4087			34/66	1.3646	11	-12
84/16	1.4080			33/67	1.3637	12	-11
83/17	1.4073			32/68	1.3629	13	-11
82/18	1.4065			31/69	1.3620	14	-10
81/19	1.4058			30/70	1.3610	14	-10
80/20	1.4050			29/71	1.3600	15	-9
79/21	1.4044			28/72	1.3590	16	-9
78/22	1.4035			27/73	1.3582	17	-9
77/23	1.4027			26/74	1.3573	17	-8
76/24	1.4019			25/75	1.3563	18	-8
75/25	1.4010	-72	-58	24/76	1.3554	19	-7
74/26	1.4004	-65	-54	23/77	1.3545	20	-7
73/27	1.4000	-60	-51	22/78	1.3536	20	-7
72/28	1.3988	-55	-49	21/79	1.3525	21	-6
71/29	1.3980	-54	-48	20/80	1.3517	22	-6
70/30	1.3973	-47	-44	19/81	1.3507	22	-6
69/31	1.3964	-44	-42	18/82	1.3498	23	-5
68/32	1.3955	-41	-41	17/83	1.3488	23	-5
67/33	1.3947	-38	-39	16/84	1.3480	24	-5
66/34	1.3939	-36	-38	15/85	1.3472	24	-4
65/35	1.3931	-33	-36	14/86	1.3461	25	-4
64/36	1.3923	-31	-35	13/87	1.3450	26	-4
63/37	1.3914	-28	-34	12/88	1.3442	26	-3
62/38	1.3906	-26	-32	11/89	1.3433	27	-3
61/39	1.3897	-24	-31	10/90	1.3423	27	-3
60/40	1.3887	-22	-30	9/91	1.3414	28	-2
59/41	1.3878	-20	-29	8/92	1.3405	28	-2
58/42	1.3870	-19	-28	7/93	1.3395	29	-2
57/43	1.3862	-17	-27	6/94	1.3386	29	-2
56/44	1.3852	-15	-26	5/95	1.3377	30	-1
55/45	1.3843	-14	-25	4/96	1.3368	30	-1
54/46	1.3833	-12	-24	3/97	1.3358	31	-1
53/47	1.3824	-11	-24	2/98	1.3350	31	-1
52/48	1.3815	-9	-23	1/99	1.3340	32	0
51/49	1.3805	-8	-22	0/100		32	0
50/50	1.3795	-7	-22				

28. DF Plus (88)

Brand Name: DF Plus (88) Concentrate and 63% Dilute — Type I
Manufacturer: Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 63% — Max. Refractive Index No: 1.399 — Max. Brix No: 39.5
2. Minimum LOUT (Lowest Operational Use Temperature): -25 °F (-32 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	51.1 - 52.7	Refractive Index	1.4225 - 1.4255	pH	7.0 - 10.0
63/37 Dilution - Brix	37.8 - 39.5	Refractive Index	1.396 - 1.399	pH	min 6.0
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0		Does Not Freeze		49/51	1.3840	-14	-25
99/1				48/52	1.3830	-12	-24
98/2				47/53	1.3820	-11	-24
97/3				46/54	1.3810	-9	-23
96/4				45/55	1.3810	-8	-22
95/5				44/56	1.3800	-7	-22
94/6				43/57	1.3780	-4	-20
93/7				42/58	1.3770	-2	-19
92/8				41/59	1.3760	-1	-18
91/9				40/60	1.3750	0	-18
90/10				39/61	1.3740	1	-17
89/11				38/62	1.3730	2	-17
88/12				37/63	1.3720	4	-16
87/13				36/64	1.3700	6	-15
86/14				35/65	1.3690	7	-14
85/15				34/66			
84/16				33/67	1.3680	9	-13
83/17				32/68	1.3660	10	-12
82/18				31/69			
81/19				30/70	1.3640	12	-11
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35				14/86			
64/36				13/87			
63/37	1.3960	-44	-42	12/88			
62/38	1.3960	-41	-41	11/89			
61/39	1.3950	-38	-39	10/90			
60/40	1.3940	-36	-38	9/91			
59/41	1.3930	-33	-36	8/92			
58/42	1.3920	-31	-35	7/93			
57/43	1.3920	-28	-34	6/94			
56/44	1.3910	-26	-32	5/95			
55/45	1.3900	-24	-31	4/96			
54/46	1.3890	-22	-30	3/97			
53/47	1.3880	-20	-29	2/98			
52/48	1.3870	-19	-28	1/99			
51/49	1.3860	-17	-27	0/100			
50/50	1.3850	-15	-26				

29. DF Sustain

Brand Name: DF sustain — Type I
Manufacturer: Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 68% — Max. Refractive Index No: 1.403 — Max. Brix No: 41.6
2. Minimum LOUT (Lowest Operational Use Temperature): -43 °F (-41 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	54.0 - 55.2	Refractive Index	1.4285 - 1.4315	pH	7.0 - 10.0
68/32 Dilution - Brix	40.2 - 41.6	Refractive Index	1.400 - 1.403%	pH	min 6.0
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.3790	-5	-20
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.3730	2	-17
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.3680	8	-14
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.3630	13	-11
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.3580	18	-8
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3530	22	-6
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85	1.3480	25	-4
65/35	1.3990	-45	-43	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90	1.3430	28	-3
60/40	1.3940	-33	-36	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95	1.3380	30	-1
55/45	1.3890	-23	-31	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.3840	-13	-25				

30. LNT E188

Brand Name: LNT E188 — Type I
Manufacturer: LNT Solutions

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70%
Max. Refractive Index No: 1.3965 - 1.3995
Max. Brix No: 38.25 - 40.0
2. Minimum LOUT (Lowest Operational Use Temperature): -41 °F (-41 °C)
Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Clear Orange 5. Base: EG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	50.25 - 51.75	Refractive Index	1.4206 - 1.4236	pH	8.0 - 9.0
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.3690	-14.8	-26
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.3680	-11.2	-24
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.3640	-9.4	-23
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.3570	8.6	-13
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.3500	15.8	-9
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.3480	19.4	-7
70/30	1.3930	-61.6	-52	19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35	1.3900	-61.6	-52	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40	1.3850	-49	-45	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45	1.3820	-38.2	-39	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100		32	0
50/50	1.3760	-25.6	-32				

31. LNT P180

Brand Name: LNT P180 — Type I
Manufacturer: LNT Solutions

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 69% — Max. Refractive Index No: 1.396 — Max. Brix No: 49.6
2. Minimum LOUT (Lowest Operational Use Temperature): -25.6 °F (-32 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424
7. Field Test Acceptability:

Concentrate - Brix	48.8 - 50.1	Refractive Index	1.417 - 1.4205	pH	7.5 - 9.5
50/50 Dilution - Brix	29.0 - 29.8	Refractive Index	1.3775 - 1.3785	pH	min 6.00
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.375	0	-18
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.370	5	-15
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.366	10	-12
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.361	14	-10
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.356	18	-8
75/25	1.401	-72	-58	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.352	22	-6
70/30				19/81			
69/31	1.396	-44	-42	18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85	1.347	24	-4
65/35	1.393	-33	-36	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90	1.342	27	-3
60/40	1.389	-22	-30	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95	1.338	29	-1
55/45	1.384	-14	-25	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.380	-7	-22				

32. LNT P188

Brand Name: LNT P-188 — Type I
Manufacturer: LNT Solutions

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 70% — Max. Refractive Index No: 1.426 — Max. Brix No: 40.8
2. Minimum LOUT (Lowest Operational Use Temperature): -14.8 °F (-26 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Orange 5. Base: PG 6. Spec: AMS 1424 & ISO 11075
7. Field Test Acceptability:

Concentrate - Brix	No Data	Refractive Index	1.4235 - 1.4265	pH	7.5 - 8.5
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)
100/0		Does not Freeze		49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55	1.378	9	-13
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60	1.373	18	-8
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65	1.369	5	-15
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70	1.364	12	-11
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75	1.358	16	-9
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80	1.353	21	-6
70/30	1.412			19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85	1.348	25	-4
65/35	1.397	-33	-36	14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90	1.343	27	-3
60/40	1.393	-24	-31	9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45	1.383	-9	-23	4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.379	1	-17				

33. FCY-1A

Brand Name: FCY-1A — Type I
Manufacturer: Newave Aerochemical

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 75% — Max. Refractive Index No: 1.404 — Max. Brix No: XX.X
2. Minimum LOUT (Lowest Operational Use Temperature): -40 °F (-40 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Colorless 5. Base: EG 6. Spec: AMS 1424J
7. Field Test Acceptability:

Concentrate - Brix	No Data	Refractive Index	1.4223 - 1.4253	pH	8.5 - 9.5%
50/50 Dilution - Brix	No Data	Refractive Index	1.3797 - 1.3827	pH	8.4 - 9.4%
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

34. Cleansurface I

Brand Name: Cleansurface I — Type I
Manufacturer: Shaanxi Cleanway Aviation

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:
1. Maximum concentration allowed for use on aircraft:
Max. concentrate % in mixture: 75% — Max. Refractive Index No: 1.4003 — Max. Brix No: 40
2. Minimum LOUT (Lowest Operational Use Temperature): -30 °F (-34 °C) — Note: High-speed aerodynamics.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Colorless 5. Base: EG 6. Spec: AMS 1424K
7. Field Test Acceptability:

Concentrate - Brix	49	Refractive Index	1.4168 - 1.4198	pH	8.5 - 9.5
75/25 Dilution - Brix	39	Refractive Index	1.3975 - 1.4003	pH	8.5 - 9.5
55/45 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/34				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

B. Approved Type II Fluids:

35. Cleanwing II

Brand Name: Cleanwing II — Type II
Manufacturer: Aviation Shaanxi Hi-Tech

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20°F (-29°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.3906 - 1.3936	pH	6.8 - 7.8
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	6,080 - 13,520	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	4,650 - 13,520	cps, cP or mPa.s
75/25 Dilution	10,000	cps, cP or mPa.s
50/50 Dilution	10,200	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV2-disc spindle with guard leg, 135 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: pale Straw 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0		-38	-39	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25		-5	-21	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50		14	-10				

36. Safewing MP II FLIGHT

Brand Name: Safewing MP II FLIGHT — Type II
Manufacturer: Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20°F (-29°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.389 - 1.392	pH	7.0 - 7.5
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	6,000 - 14,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	3,340 - 20,500	cps, cP or mPa.s
75/25 Dilution	12,900	cps, cP or mPa.s
50/50 Dilution	11,500	cps, cP or mPa.s

Note: 100% & 50% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
Note: 75% Viscosity measured using Brookfield, LV2-disc spindle with guard leg, 425 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Yellowish 5. Base: PG 6. Spec: AMS 1428 & ISO 11075

Source:2017 Clarinat (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.390	-33	-36	49/51	1.363	13	-10
99/1	1.390	-31	-35	48/52	1.362	14	-10
98/2	1.398	-30	-34	47/53	1.362	14	-10
97/3	1.389	-28	-34	46/54	1.361	15	-10
96/4	1.388	-26	-32	45/55	1.361	15	-10
95/5	1.388	-25	-31	44/56	1.359	15	-9
94/6	1.388	-23	-31	43/57	1.359	16	-9
93/7	1.387	-22	-30	42/58	1.358	17	-9
92/8	1.387	-21	-29	41/59	1.358	18	-8
91/9	1.386	-19	-28	40/60	1.357	19	-8
90/10	1.385	-18	-28	39/61	1.356	19	-7
89/11	1.385	-17	-27	38/62	1.356	19	-7
88/12	1.384	-16	-27	37/63	1.355	20	-7
87/13	1.384	-15	-26	36/64	1.355	20	-7
86/14	1.383	-14	-25	35/65	1.354	20	-7
85/15	1.383	-13	-25	34/66	1.353	20	-6
84/16	1.382	-12	-24	33/67	1.353	21	-6
83/17	1.381	-11	-24	32/68	1.352	21	-6
82/18	1.381	-10	-24	31/69	1.351	22	-6
81/19	1.380	-9	-23	30/70	1.351	22	-6
80/20	1.380	-9	-23	29/71	1.350	23	-5
79/21	1.379	-8	-22	28/72	1.350	23	-5
78/22	1.379	-7	-22	27/73	1.349	24	-5
77/23	1.378	-7	-22	26/74	1.348	24	-4
76/24	1.377	-6	-21	25/75	1.348	25	-4
75/25	1.377	-5	-21	24/76	1.347	25	-4
74/26	1.376	-5	-20	23/77	1.347	25	-4
73/27	1.376	-4	-20	22/78	1.346	26	-4
72/28	1.375	-3	-19	21/79	1.346	26	-3
71/29	1.375	-2	-19	20/80	1.345	27	-3
70/30	1.374	-2	-19	19/81			
69/31	1.374	-1	-18	18/82			
68/32	1.373	0	-18	17/83			
67/33	1.373	1	-17	16/84			
66/33	1.372	2	-17	15/85			
65/35	1.372	2	-17	14/86			
64/36	1.371	3	-16	13/87			
63/37	1.371	4	-16	12/88			
62/38	1.370	5	-15	11/89			
61/39	1.369	6	-15	10/90			
60/40	1.369	7	-14	9/91			
59/41	1.368	7	-14	8/92			
58/42	1.368	8	-13	7/93			
57/43	1.367	9	-13	6/94			
56/44	1.366	10	-13	5/95			
55/45	1.365	10	-12	4/96			
54/46	1.365	11	-12	3/97			
53/47	1.364	11	-12	2/98			
52/48	1.364	12	-11	1/99			
51/49	1.364	12	-11	0/100			
50/50	1.363	13	-11				

37. Polar Guard II

Brand Name	Polar Guard II	Type II
Manufacturer	Cryotech	

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-22.9°F (-30.5°C)
75/25 Dilution	7°F (-14°C)
50/50 Dilution	26°F (-3.5°C)

2. Field Test Acceptability:

100% Neat - Brix	32.5 - 36.5	Refractive Index	1.390 - 1.393	pH	6.4 - 7.4
75/25 Dilution - Brix	27.6 - 29.9	Refractive Index	1.3768 - 1.3809	pH	6.4 - 7.4
50/50 Dilution - Brix	19.0 - 21.5	Refractive Index	1.3622 - 1.3663	pH	6.4 - 7.4

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	4,050 - 16,200	cps, cP or mPa.s
75/25 Dilution	9,750 - 38,000	cps, cP or mPa.s
50/50 Dilution	80 - 48,000	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	4,050	cps, cP or mPa.s
75/25 Dilution	9,750	cps, cP or mPa.s
50/50 Dilution	80	cps, cP or mPa.s

Note: 100% & 75% Viscosity measured using Brookfield, SC4-34/13R spindle, small sample adapter, 10 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
Note: 50% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Yellow, Straw 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-36	-38	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25	1.378	-6	-21	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.363	13	-11				

38. ABC-K Plus

Brand Name: ABC-K Plus — Type II
Manufacturer: Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20.2°F (-29°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.3900 - 1.3930	pH	6.0 - 8.0
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	5,000 - 9,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	2,850	cps, cP or mPa.s
75/25 Dilution	12,650	cps, cP or mPa.s
50/50 Dilution	5,260	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV2-disc spindle with guard leg, 135 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Pale Yellow 5. Base: PG 6. Spec: AMS 1428 & ISO 11075

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-35	-37	49/51	1.362	13	-10
99/1	1.391	-33	-36	48/52	1.361	14	-10
98/2	1.391	-32	-35	47/53	1.361	14	-10
97/3	1.390	-30	-35	46/54	1.360	14	-10
96/4	1.389	-29	-34	45/55	1.359	15	-10
95/5	1.389	-27	-33	44/56	1.359	15	-9
94/6	1.388	-26	-32	43/57	1.358	16	-9
93/7	1.387	-25	-32	42/58	1.358	16	-9
92/8	1.387	-23	-31	41/59	1.357	17	-8
91/9	1.386	-22	-30	40/60	1.356	17	-8
90/10	1.386	-21	-29	39/61	1.356	18	-8
89/11	1.385	-20	-29	38/62	1.355	18	-8
88/12	1.384	-18	-28	37/63	1.355	19	-7
87/13	1.384	-17	-27	36/64	1.354	19	-7
86/14	1.383	-16	-27	35/65	1.354	20	-7
85/15	1.383	-15	-26	34/66	1.353	20	-7
84/16	1.382	-14	-25	33/67	1.352	21	-6
83/17	1.382	-13	-25	32/68	1.352	21	-6
82/18	1.381	-12	-24	31/69	1.351	22	-6
81/19	1.380	-11	-24	30/70	1.351	22	-6
80/20	1.380	-10	-23	29/71	1.350	23	-5
79/21	1.379	-9	-23	28/72	1.349	23	-5
78/22	1.379	-8	-22	27/73	1.349	23	-5
77/23	1.379	-8	-22	26/74	1.348	24	-5
76/24	1.378	-7	-22	25/75	1.348	24	-4
75/25	1.377	-7	-21	24/76	1.347	24	-4
74/26	1.376	-5	-21	23/77	1.346	25	-4
73/27	1.376	-4	-20	22/78	1.346	25	-4
72/28	1.375	-3	-19	21/79	1.345	26	-4
71/29	1.375	-2	-19	20/80	1.345	26	-3
70/30	1.374	-1	-18	19/81			
69/31	1.373	0	-18	18/82			
68/32	1.373	0	-18	17/83			
67/33	1.372	1	-17	16/84			
66/33	1.372	2	-17	15/85			
65/35	1.371	3	-16	14/86			
64/36	1.371	3	-16	13/87			
63/37	1.370	4	-16	12/88			
62/38	1.369	5	-15	11/89			
61/39	1.369	5	-15	10/90			
60/40	1.368	6	-15	9/91			
59/41	1.368	7	-14	8/92			
58/42	1.367	7	-14	7/93			
57/43	1.366	8	-13	6/94			
56/44	1.366	8	-13	5/95			
55/45	1.365	9	-13	4/96			
54/46	1.365	10	-12	3/97			
53/47	1.364	10	-12	2/98			
52/48	1.364	11	-12	1/99			
51/49	1.363	12	-11	0/100			
50/50	1.362	13	-11				

39. FCY-2

Brand Name: FCY-2 — Type II
Manufacturer: Newave Aerochemical

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-18°F (-28°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.3915 - 1.3945	pH	6.7 - 7.7
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	11,000 - 23,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	18,550	cps, cP or mPa.s
50/50 Dilution	7,030	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV2-disc spindle with guard leg, 135 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Clear to Light Straw 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates. RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0		-31	-35	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25		-5	-21	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50		14	-10				

C. Approved Type III Fluids:

40. AeroClear MAX

Brand Name: AeroClear MAX — Type III
Manufacturer: AllClear Systems

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-31°F (-28°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	33.2 - 34.2	Refractive Index	1.3865 - 1.3895	pH	7.5 - 8.5
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	12,500 - 15,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

Note: 100% Viscosity measured using Brookfield, SC4-31/13R spindle, small sample adapter, 9 mL fluid, 32 °F (0 °C) & 0.3 rpm for 65 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Yellow 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.388	-45	-43	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

D. Approved Type IV Fluids:

41. Ecowing AD-49

Brand Name: Ecowing AD-49 — Type IV
Manufacturer: ABAX

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-14.8°F (-26°C)
75/25 Dilution	3°F (-16°C)
50/50 Dilution	17.6°F (-8°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.3905 - 1.3935	pH	6.5 - 7.5
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	11,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with SC4-31/13R spindle & small sample adapter, 10 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Green 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-27	-33	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25	1.377	-9	-23	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50	1.362	5	-15				

42. CHEMR EG IV

Brand Name CHEMR EG IV Type IV
Manufacturer Chemco Inc

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-16,6°F (-27°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	32,0 - 36,0	Refractive Index	1.385 - 1.392	pH	8,0 - 9,0
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	47000 - 67000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	46,500	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Green 5. Base: EG 6. Spec: AMS 1428

Source:2018 Chemco (claude.grenon@chemco-inc.com)

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.389	-16	-27
75/25			
50/50			

43. ChemR Nordik IV

Brand Name: ChemR Nordik IV — Type IV

Manufacturer: Chemco Inc

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20.2°F (-29°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	31.0 - 35.0	Refractive Index	1.383 - 1.390	pH	8.0 - 9.0
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	60,800 - 84,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	60,800	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Green 5. Base: EG 6. Spec: AMS 1428

Source:2018 Chemco (claude.grenon@chemco-inc.com)

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.383	-40	-40
75/25			
50/50			

44. Safewing MP IV LAUNCH

Brand Name	Safewing MP IV Launch	Type IV
Manufacturer	Clariant	

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-19°F (-28.5°C)
75/25 Dilution	7°F (-14°C)
50/50 Dilution	27°F (-3°C)

2. Field Test Acceptability:

100% Neat - Brix	34.5 - 36.1	Refractive Index	1.3895 - 1.3925	pH	7.0 - 7.5
75/25 Dilution - Brix	26.8 - 28.6	Refractive Index	1.3755 - 1.3804	pH	6.5 - 7.5
50/50 Dilution - Brix	18.6 - 21.5	Refractive Index	1.3615 - 1.3664	pH	6.5 - 7.5

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	10,000 - 20,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	7,550 - 20, 500	cps, cP or mPa.s
75/25 Dilution	18,000 - 47,800	cps, cP or mPa.s
50/50 Dilution	17,800 - 63,000	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

5. Freezing point of dilution - must be at least 13°F / 7°C below actual OAT:

6. Color: Green 7. Base: PG 8. Spec: AMS 1428/1

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.3895 - 1.3925	-32.8	-36
75/25	1.3855 - 1.3804	-5.8	-21
50/50	1.3615 - 1.3664	14	-10

45. Safewing MP IV Launch Plus

Brand Name Safewing MP IV Launch Plus Type IV

Manufacturer Clariant

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20°F (-29°C)
75/25 Dilution	7°F (-14°C)
50/50 Dilution	27°F (-3°C)

2. Field Test Acceptability:

100% Neat - Brix	Need Data	Refractive Index	1.390 - 1.393	pH	7.0 - 7.5
75/25 Dilution - Brix	Need Data	Refractive Index	1.376 - 1.380	pH	6.5 - 7.5
50/50 Dilution - Brix	Need Data	Refractive Index	1.362 - 1.366	pH	6.5 - 7.5

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	8,700 - 21,000	cps, cP or mPa.s
75/25 Dilution	18,800 - 51,600	cps, cP or mPa.s
50/50 Dilution	9,700 - 65,700	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

5. Freezing point of dilution - must be at least 13°F / 7°C below actual OAT:

6. Color: Green 7. Base: PG 8. Spec: AMS 1428/1

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.390-1.393	-32.8	-36
75/25	1.376-1.380	-5.8	-21
50/50	1.362-1.366	14	-10

46. Polar Guard Advance

Brand Name: Polar Guard Advance — Type IV
Manufacturer: Cryotech

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-22.9°F (-30.5°C)
75/25 Dilution	7°F (-14°C)
50/50 Dilution	26°F (-3.5°C)

2. Field Test Acceptability:

100% Neat - Brix	34.6 - 36.6	Refractive Index	1.390 - 1.393	pH	6.4 - 7.4
75/25 Dilution - Brix	27.6 - 29.9	Refractive Index	1.3768 - 1.3809	pH	6.4 - 7.4
50/50 Dilution - Brix	19.0 - 21.5	Refractive Index	1.3622 - 1.3663	pH	6.4 - 7.4

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	5,000 - 16,200	cps, cP or mPa.s
75/25 Dilution	9,750 - 38,000	cps, cP or mPa.s
50/50 Dilution	80 - 48,000	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	4,050	cps, cP or mPa.s
75/25 Dilution	9,750	cps, cP or mPa.s
50/50 Dilution	80	cps, cP or mPa.s

Note: 100% & 75% Viscosity measured using Brookfield, SC4-34/13R spindle, small sample adapter, 10 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
Note: 50% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
5. Freezing point of dilution - must be at least 13°F / 7°C below actual OAT:
6. Color: Green 7. Base: PG 8. Spec: AMS 1428/1

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-36	-38	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75		-13	-11
75/25	1.378	-6	-21	24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

Cryotech Polar Guard Advanced is recommended to be applied as NEAT (undiluted v/v).
HOT are available for 100/0, 75/25 & 50/50.

47. Polar Guard Xtend

Brand Name: Polar Guard Xtend — Type IV
Manufacturer: Cryotech

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20°F (-29°C)
75/25 Dilution	Not Applicable
50/50 Dilution	Not Applicable

2. Field Test Acceptability:

100% Neat - Brix	34.6 - 36.6	Refractive Index	1.390 - 1.393	pH	6.2 - 7.2
75/25 Dilution - Brix	Not Applicable	Refractive Index	Not Applicable	pH	Not Applicable
50/50 Dilution - Brix	Not Applicable	Refractive Index	Not Applicable	pH	Not Applicable

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	6,350 - 23,200	cps, cP or mPa.s
75/25 Dilution	Not Applicable	cps, cP or mPa.s
50/50 Dilution	Not Applicable	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	6,350	cps, cP or mPa.s
75/25 Dilution	Not Applicable	cps, cP or mPa.s
50/50 Dilution	Not Applicable	cps, cP or mPa.s

Note: 100% & 75% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
Note: 50% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
5. Freezing point of dilution - must be at least 13°F / 7°C below actual OAT:
6. Color: Green 7. Base: PG 8. Spec: AMS 1428/1

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-36	-38	49/51			

Cryotech Polar Guard Xtend is recommended to be applied as NEAT (undiluted v/v).
HOT are available for 100/0.

48. UCAR Endurance EG106 De/Anti-Icing Fluid

Brand Name UCAR Endurance EG106 ADF/AAF Type IV
Manufacturer Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20°F (-29°C)
75/25 Dilution	Do not dilute
50/50 Dilution	Do not dilute

2. Field Test Acceptability:

100% Neat - Brix	30.5 - 33.5	Refractive Index	1.3820 - 1.3874	pH	7.9 - 8.9
75/25 Dilution - Brix	Do not dilute	Refractive Index	Do not dilute	pH	Do not dilute
50/50 Dilution - Brix	Do not dilute	Refractive Index	Do not dilute	pH	Do not dilute

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	29,500 - 47,800	cps, cP or mPa.s
75/25 Dilution	Do not dilute	cps, cP or mPa.s
50/50 Dilution	Do not dilute	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	24,850	cps, cP or mPa.s
75/25 Dilution	Do not dilute	cps, cP or mPa.s
50/50 Dilution	Do not dilute	cps, cP or mPa.s

Note: 100% Viscosity measured using Brookfield, 3C4-31/13R spindle, small sample adapter, 10 mL fluid, 32 °F (00 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Green 5. Base: EG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
Do Not Dilute			

49. UCAR FlightGuard AD-49

Brand Name UCAR FlightGuard AD-49 Type IV
Manufacturer Dow Chemical Company

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-14°F (-26°C)
75/25 Dilution	7°F (-14°C)
50/50 Dilution	27°F (-3°C)

2. Field Test Acceptability:

100% Neat - Brix	35.2 - 36.8	Refractive Index	1.3905 - 1.3935	pH	6.5 - 7.5
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	13,000 - 20,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with SC4-31/13R spindle & small sample adapter, 10 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Green 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-27	-33	Do not dilute			
Do not dilute				Do not dilute			

50. ECO-SHIELD

Brand Name: ECO-SHIELD — Type IV
Manufacturer: Inland Technologies

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-12.1°F (-24.5°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.390 - 1.393	pH	6.7 - 7.3
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	3,000 - 6,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	Need Data	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

Note: 100% Viscosity measured using Brookfield, SC4-31/13R spindle, small sample adapter, 10 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
Note: 75% & 50% Viscosity measured using Brookfield, LV1 spindle with guard leg, 575 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.
5. Freezing point of dilution - must be at least 13°F / 7°C below actual OAT:
6. Color: Green 7. Base: PG 8. Spec: AMS 1428/1

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.390	-29	-34	49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

51. ABC-S Plus

Brand Name ABC-S PLUS Type IV
Manufacturer Kilfrost

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-18.4°F (-28°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.39 - 1.3930	pH	6.0 - 8.0%
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	24,000 - 30,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	17,900	cps, cP or mPa.s
75/25 Dilution	18,300	cps, cP or mPa.s
50/50 Dilution	7,500	cps, cP or mPa.s

Note: Viscosities measured using Brookfield with LV2-disc spindle with guard leg, 135 mL fluid, 68 °F (20 °C) & 0.3 rpm for 10 min.

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:

4. Color: Green 5. Base: PG 6. Spec: AMS 1428

Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°C) (±1°C)
100/0	1.392	-35	-37	49/51	1.362	13	-10
99/1	1.391	-33	-36	48/52	1.361	14	-10
98/2	1.391	-32	-35	47/53	1.361	14	-10
97/3	1.390	-30	-35	46/54	1.360	13	-10
96/4	1.389	-29	-34	45/55	1.359	15	-10
95/5	1.389	-27	-33	44/56	1.359	15	-9
94/6	1.388	-26	-32	43/57	1.358	16	-9
93/7	1.387	-25	-32	42/58	1.358	16	-9
92/8	1.387	-23	-31	41/59	1.357	17	-8
91/9	1.386	-22	-30	40/60	1.356	17	-8
90/10	1.386	-21	-29	39/61	1.356	18	-8
89/11	1.385	-20	-29	38/62	1.355	18	-8
88/12	1.384	-18	-28	37/63	1.355	19	-7
87/13	1.384	-17	-27	36/64	1.354	19	-7
86/14	1.383	-16	-27	35/65	1.354	20	-7
85/15	1.383	-15	-26	34/66	1.353	20	-7
84/16	1.382	-14	-25	33/67	1.352	21	-6
83/17	1.382	-13	-25	32/68	1.352	21	-6
82/18	1.381	-12	-24	31/69	1.351	22	-6
81/19	1.380	-11	-24	30/70	1.351	22	-6
80/20	1.380	-10	-23	29/71	1.350	23	-5
79/21	1.379	-9	-23	28/72	1.349	23	-5
78/22	1.379	-8	-22	27/73	1.349	23	-5
77/23	1.379	-8	-22	26/74	1.348	24	-5
76/24	1.378	-7	-22	25/75	1.348	24	-4
75/25	1.377	-7	-21	24/76	1.347	24	-4
74/26	1.376	-5	-21	23/77	1.346	25	-4
73/27	1.376	-4	-20	22/78	1.346	25	-4
72/28	1.375	-3	-19	21/79	1.345	26	-4
71/29	1.375	-2	-19	20/80	1.345	26	-3
70/30	1.374	-1	-18	19/81			
69/31	1.373	0	-18	18/82			
68/32	1.373	0	-18	17/83			
67/33	1.372	1	-17	16/84			
66/33	1.372	2	-17	15/85			
65/35	1.371	3	-16	14/86			
64/36	1.371	3	-16	13/87			
63/37	1.370	4	-16	12/88			
62/38	1.369	5	-15	11/89			
61/39	1.369	5	-15	10/90			
60/40	1.368	6	-15	9/91			
59/41	1.368	7	-14	8/92			
58/42	1.367	7	-14	7/93			
57/43	1.366	8	-13	6/94			
56/44	1.366	8	-13	5/95			
55/45	1.365	9	-13	4/96			
54/46	1.365	10	-12	3/97			
53/47	1.364	10	-12	2/98			
52/48	1.364	11	-12	1/99			
51/49	1.363	12	-11	0/100			
50/50	1.362	13	-11				

52. FCY 9311

Brand Name: FCY 9311 — Type IV
Manufacturer: Newave Aerochemical

Fluids(s) must meet all of the following criteria before it can be applied to aircraft and aircraft dispatched:

1. LOUT (Lowest Operational Use Temperature) for:
Note: High-speed aerodynamics.

100% Neat	-20.7°F (-29.5°C)
75/25 Dilution	XX°F (-XX°C)
50/50 Dilution	XX°F (-XX°C)

2. Field Test Acceptability:

100% Neat - Brix	No Data	Refractive Index	1.3919 ± 0.0015	pH	7.3 ± 0.5
75/25 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data
50/50 Dilution - Brix	No Data	Refractive Index	No Data	pH	No Data

3. Acceptable viscosity range for delivery using Manufacturer Method

100% Neat	18,000 - 29,000	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

4. Acceptable viscosity range for Lowest on Wing (LOWV) using Manufacturer Method

100% Neat	14,100	cps, cP or mPa.s
75/25 Dilution	Need Data	cps, cP or mPa.s
50/50 Dilution	Need Data	cps, cP or mPa.s

3. Freezing point of dilution - must be at least 18 deg F / 10 deg C below actual OAT:
4. Color: Clear Green 5. Base: PG 6. Spec: AMS 1428J

Source:2017 Clariant (tiffany.meyers@clariant.com)
Table below is for field use estimating mixture rates, RI & FP.

Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)	Diluton (v/v) (prod/water)	Refractive Index (20°C/68°F) (±.0015)	Freezing Point (°F) (±2°F)	Freezing Point (°c) (±1°C)
100/0				49/51			
99/1				48/52			
98/2				47/53			
97/3				46/54			
96/4				45/55			
95/5				44/56			
94/6				43/57			
93/7				42/58			
92/8				41/59			
91/9				40/60			
90/10				39/61			
89/11				38/62			
88/12				37/63			
87/13				36/64			
86/14				35/65			
85/15				34/66			
84/16				33/67			
83/17				32/68			
82/18				31/69			
81/19				30/70			
80/20				29/71			
79/21				28/72			
78/22				27/73			
77/23				26/74			
76/24				25/75			
75/25				24/76			
74/26				23/77			
73/27				22/78			
72/28				21/79			
71/29				20/80			
70/30				19/81			
69/31				18/82			
68/32				17/83			
67/33				16/84			
66/33				15/85			
65/35				14/86			
64/36				13/87			
63/37				12/88			
62/38				11/89			
61/39				10/90			
60/40				9/91			
59/41				8/92			
58/42				7/93			
57/43				6/94			
56/44				5/95			
55/45				4/96			
54/46				3/97			
53/47				2/98			
52/48				1/99			
51/49				0/100			
50/50							

HOLDOVER TIME

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HOLDOVER TIME

HOLDOVER TIME

HOLDOVER TIME

Please visit the web address to the FAA Aircraft Ground Deicing page which contains the most current version of the Holdover Time Tables. This list is all fluids accepted by the FAA. United Engineering must approve all fluid in use. For a list of fluids approved for use by United Engineering please reference 06-01-01 of this manual.

EQUIPMENT & FACILITIES SAFETY

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EQUIPMENT & FACILITIES SAFETY

EQUIPMENT & FACILITIES SAFETY

EQUIPMENT, FLUID STORAGE FACILITIES & SAFETY

1. General / Policy Overview

   A. This section contains information regarding safety equipment, references to ground equipment and glycol fluid handling and storage.

2. Purpose

   A. This section provides information as well as part number references for all safety related tools used for deicing related activities. United personal protective equipment (PPE) must meet all Federal, State, or other Regulatory Agency requirements. This section also contains environmental references and proper fluid handling and storage techniques.

3. Scope

   A. This information is intended for United personnel and Service Providers who perform deicing related activities on United aircraft.

4. Ground Equipment, Facilities and Fluids

   A. Each applicable station submits a winter operations plan to the Winter Operations Management Program (WOMP), prior to their readiness date. The plan is reviewed by the Winter Operations corporate team who confirms readiness which includes meeting necessary standards for equipment, and fluid storage facilities to ensure a safe operation. Any station not meeting these standards will have their plan rejected outlining the issues needing to be corrected. If a station continues to be rejected assistance will be provided to the station up to acceptable levels prior to their first winter event. Airport Operations Quality Control audits stations against the standards in this manual to ensure they continue to meet the standards after the readiness date.

   B. Planning

      (1) All deicing / anti-icing equipment (including storage, heating and dispensing facilities) must be properly winterized per the preseason checks.

      (2) All deicing trucks and support equipment must have preseason preventative maintenance checks done per the GSE program requirements.

         (a) Preseason preventative maintenance checks must include a process to ensure Type I temperature gauges are accurate.

         (b) This process is performed by qualified technicians.

      (3) Deicing equipment will not be altered or modified without the approval of Ground Equipment (WHQGX).

         (a) When components of the thickened fluid system have gone through a maintenance procedure, the system will be taken out of service and require a full laboratory test as described in Chapter 6 Pre-season Fluid Readiness Check. This Laboratory test will include a test on Viscosity, pH, Refractive Index and Appearance and the sample will be taken from the nozzle to ensure the integrity of the entire system. Individual items requiring this check include, but are not limited to:

            1 Thickened fluid pumps (replacement, rebuild or change of parts)

            2 Thickened fluid nozzle adjustments or replacements

3 Thickened fluid pressure adjustments

4 Thickened fluid plumbing changes

(b) Upon a full passing test result, the system may be put back into service.

(4) Spare parts inventory shall be reviewed (United and Service Provider's equipment) to ensure adequate supply for winter operation.

(5) Deicing Service Providers must notify the station Deicing Coordinator / Operational Person in Charge (Ground Handler) upon completion of the preseason checks.

(6) Type I and Type II / III or IV fill ports must not be the same type and / or size.

5. Fluid Storage Requirements

A. Type I storage (tanks, tankers or deicing trucks) or stationary fill ports and facility tanks will be placarded with the following information:

(1) Type I

(2) Glycol base – (propylene).

(3) Tank identification

B. Type II, III or IV storage (tanks, tankers or deicing trucks) or stationary fill ports and facility tanks will be placarded with the following information:

(1) Type II, III or IV

(2) Glycol base – (propylene)

(3) Manufacturer's name and fluid name

(4) On facility tanks only (tanks, totes, drums, etc.) if fluid is other than concentrate indicate percent. (75%, 50%, etc.)

(5) Tank identification

C. Additions of fluids to all United and Service Provider tanks must be checked and recorded for proper concentration.

CAUTION: **FLUIDS MEETING THE AMS1428/1/2 SPECIFICATION (TYPE II, III AND IV) ARE UNIQUE TO EACH OTHER AND MAY BE ADVERSELY AFFECTED BY MIXING WITH OTHER AIRCRAFT DEICING / ANTI-ICING FLUIDS.**

D. All types of Storage Tank vents and access openings must be designed to keep out rain, insects and debris.

E. Type II, III or IV fluids must be stored in facilities and equipment designed for these materials in order to minimize viscosity losses from mechanical shearing, chemical degradation from rust and ultraviolet ray degradation from sunlight.

F. Type II, III and IV tanks should be constructed of stainless steel, fiberglass or plastic. Carbon steel is acceptable if the inside of the tank has been coated with a suitable material resistant to Type II, III or IV fluids. If constructed of fiberglass or plastic the tank should be designed to block sunlight, either by coating or by additives to the construction material. If the tank is

painted, regardless of construction material, and is located outside in direct sunlight a light color is preferred to avoid heating the fluid excessively during warm weather storage.

G. Steel / Carbon Steel tanks containing Type II, III or IV fluid must receive an external visual inspection annually for evidence of corrosion.

(1) The local Facility Maintenance Team will have the responsibility to perform a visual inspection of the United Airlines owned above ground tanks on an annual basis. The results will be kept in the Fleet Focus database to be used for analysis and issue mitigation by the CWOC.

(2) Visually inspect all available sides and underneath the tank, hoses and hose connections for leaks.

(3) Visually inspect all surfaces for rust / corrosion.

(a) Some external rust is expected and can be avoided through regular sanding and painting. If corrosion is excessive or tank integrity is a concern contact Facilities Maintenance / Field Services for further evaluation.

H. Type II, III and IV tank piping and fittings must be constructed of plastic, stainless steel (preferred) or aluminum. In addition, the pipes and fittings should be designed with slight bends (45 degrees or less) to prevent excessive shearing of the fluid. A limited number of 90 degrees bends are allowed in a single delivery system.

(1) Steel reinforced rubber hoses are required for delivery of fluid into deicing trucks from supply tanks.

I. To prevent water loss from Type II, III or IV fluids in deicers tanks during non-winter months, the fluid may be transferred back into the main storage of the deicer tank openings sealed with a plastic wrap (SARAN) or other moisture impermeable film. If drained, rinse the truck tanks with hot water and drain prior to implementing normal summer storage procedures.

6. Fluid Environmental Handling

A. Confine the aircraft deicing / anti-icing process to areas approved for deicing / anti-icing by the Airport Authority.

CAUTION: **NOTIFY LOCAL UNITED MANAGEMENT IMMEDIATELY IF A SPILL OCCURS.**

7. Fluid Personnel Handling

A. Avoid direct inhalation of deicing / anti-icing mists or spray, material getting into eyes and prolonged skin contact.

B. Deicing / anti-icing fluids may cause the ground or equipment to be slippery - particularly under low humidity or non-precipitation weather conditions.

C. United recommends the use of Propylene Glycol (PG) in proximity to United personnel to eliminate potential exposure.

NOTE 1: **An exposure assessment shall be conducted in the event that United employees are exposed to Ethylene Glycol (EG). Contact the Safety and Regulatory Compliance department to initiate this process.**

NOTE 2: **For additional information, refer to safety data sheet (SDS).**

8. Equipment Training and Safety

   A. Topics are included in annual deicing / anti-icing equipment operating procedures training.

   B. Training includes complete knowledge of United's work rules, all governmental regulations and manufacturer's operator and safety manuals relative to this machine's safe use.

   C. You must not operate a deicer unless you are trained, certified and in compliance with safety rules.

   D. Cautions as applicable:

      (1) Fall protection harness and lanyard must be worn by personnel on any open basket deicing equipment. The lanyard must be attached to an approved anchor point.

         (a) Enclosed upper cabs are also required to utilize safety belts when personnel are operating the upper cab.

      (2) Any person riding in an open basket during deicing conditions must wear United approved eye protection and PVC insulated gloves. (United approved heavy gloves should be worn to prevent burns to the hands) Splash resistant PPE is recommended.

      (3) In an emergency requiring immediate shutoff of the engine, boom or heater, follow the instructions provided for operation of the particular vehicle type.

      (4) At no time during a deicing operation is the vehicle to pass under the aircraft wings or tail surfaces. The vehicle is to skirt the outside periphery of the horizontal tail surfaces and wings as well as the fuselage.

      (5) If any part of the deicing equipment makes contact with the surfaces of the aircraft, it must be reported immediately to the Captain of the aircraft or supervisor as applicable. Though no external damage may be present significant internal damage may have occurred.

      (6) When operating the unit with a person in the basket or while moving around the airplane, the transmission selector must be placed in the "low" position.

      (7) Do not operate integral heaters on deicing equipment unless they are approved for use at the aircraft.

      (8) Unless approved, do not operate fluid heaters inside any building, hangar or other enclosed structure or within 50 feet of aircraft or fueling vehicles.

      (9) Do not exceed 4 mph with person in basket or with spring lockouts engaged.

      (10) Do not exceed 25 mph when fluid tanks are filled.

      (11) Operate all controls slowly for smooth platform motion.

9. Refractometers

   A. Fluids must be checked for quality before acceptance and use per Title 14 of the Code of Federal Regulations 14 CFR Part 121.629 United uses a tool called a refractometer to verify fluid concentration. Refractometer must be checked for accuracy on a daily basis when in use. Documentation of this check must be retained.

   B. The freeze point depression for aircraft deicing fluid is due to the glycol base. The addition of glycol to water will lower the freezing point of the water mixture. When measuring the freeze

point depression for solutions, it is recommended that an optical refractometer measurement be used instead of density procedure type measurements. The principal advantage for the optical procedure is that the refractive properties of ethylene glycol are not nearly as sensitive to temperature as is the density, in contrast to the PG refractive properties which are sensitive to the temperature and require that the readings be temperature compensated.

C. List of United Recommended Refractometer

(1) Atago:

(a) BR-1

(b) BR-1E

(c) PAL-ADF

(2) Misco:

(a) Misco 7084

(b) Misco DFR 211

(c) Misco 7084VP+

(d) Misco Palm Abbe 202

(e) Misco Palm Abbe 203

(3) The generic Misco scale should be used for all fluids, except for Kilfrost and Cryotech Polar Plus LT. This only applies for PG scales. Check with your manufacturer for the proper scale.

(4) The ATAGO BR-1, ATAGO BR-1E, ATAGO PAL-ADF, MISCO DFR 211, MISCO 7084VP+, PALM ABBE PA202 and PALM ABBE PA203 -hand held refractometer or equivalent are the recommended devices for measurement of freeze point.

(5) The MISCO DFR 211 -has a large window for LCD display, is gray in color and comes with four different scales.

D. The MISCO 7084VP+ -refractometer is international orange in color. This instrument will provide an accurate freeze point reading (Automatically Temperature Compensated) for mixtures with a concentration of 60 percent or less deicing fluid.

(1) The PALM ABBE PA202 -reads “Refractive Index” directly on “RI” scale. It can also read BRIX number directly on BRIX scale, generic or fluid specific freezing points.

E. MISCO Palm Abbe (Digital Handheld Refractometer)

(1) The PALM ABBE PA203 -reads “Refractive Index” directly on “RI” scale, reads BRIX number directly on BRIX scale or can be programmed to read generic or fluid specific freezing points.

F. The ATAGO BR-1 and BR-1E - Handheld Refractometer provides a freezing point reading.

(1) Measurement range for PG

(a) Concentration Scale: 0% to 70%

(b) Freezing temperature scale: 0°C to -50°C

(2) Measurement range for EG

(a) Concentration Scale: 0% to 70%

(b) Freezing temperature scale: 0°C to -50°C.

G. The ATAGO PAL-ADF - Digital Handheld Refractometer reads “Refractive Index” directly on the scale.

(1) Measurement range

(a) Main Scale: Refractive Index 1.333 to 1.426 (Display value 333 to 426)

(b) Secondary Scale: Propylene glycol Freezing temperature 0 to -50°C

NOTE: **United allows the use of equivalent refractometer.**

DOCUMENTATION

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DOCUMENTATION

DOCUMENTATION

DOCUMENTATION

1. General / Policy Overview

   A. This section contains information on all documents required as part of United's winter operations.

2. Purpose

   A. This section provides details on how to complete the various deicing related forms and how long to retain them.

3. Scope

   A. This information covers all United personnel, external handling agents and Service Providers who perform all deicing related activities on United aircraft.

4. Documentation of Operations

   A. Records Policy

      (1) All cold weather stations must report operational readiness and maintain records relative to aircraft deicing.

      (2) The United Station deicing / anti-icing record is to be used for documenting the deicing / anti-icing of aircraft.

      (3) Unless otherwise specified, records must be retained locally.

      (4) Records may be either paper or electronic as long as the format includes required information for that record. Electronic records must have a periodic back-up process in place.

      (5) Service Providers must maintain their own training and certification records, (if not maintained in the United Airlines LCMS) Type I, II, III & IV Fluid Receipt and Acceptance Record and Aircraft Deicing / Anti-icing records, deicer unit checks. These records may be of the Service Provider's format but must include the requirements as stated in this program. These records must be available for auditing.

      (6) All applicable fields must be populated.

      (7) Third Party Suppliers may use their company supplied employee ID number on all forms as long as a cross reference list is posted and provided to the local United station for reference and training verification.

   B. Program Documentation Planning and Process Displays

      (1) Additional information for planning and processes may be found in the Winter Operations SharePoint in Flying Together.

         (a) Winter Operations Sharepoint

            1 Cold Weather Stations

            2 Target Readiness Date

            3 Program Contacts

a Operational Support

b Technical Support

(b) Winter Operations Management Program

1 Approved Service Providers (Fixed Based Operators FBO)

C. Training and Certification Records

(1) United employees will use the designated electronic Learning Content Management System.

(2) Records will be readily available for station use, FAA inspection and Quality Assurance audits.

D. Daily Refractometer Log

(1) When in use:

(a) Station

(b) Deicing Provider

(c) Unit number

(d) Record your United employee number (if issued)

(e) Date

(f) Record results of user check (pass / fail) on a local log

(g) Retain for one day

CAUTION: **ANY REFRACTOMETER FAILING THIS CHECK MUST BE TAKEN OUT OF SERVICE.**

E. Aircraft Deicing / Anti-icing Record

(1) The Aircraft Deicing / Anti-icing Record must be completed after each Deicing / Anti-icing procedure or Clean Wing. The following items must be documented.

(a) Station

(b) Deicing Provider

(c) Date

(d) Equipment ID Number

(e) Driver name and employee number

(f) Sprayer name and employee number

(g) IATA Flight Number of Marketing Carrier

(h) Aircraft Registration Number

(i) Type I Freezing Point

(j) Type IV Refractive Index

(k) Type II/III/IV Mixture Rate (if applicable)

(l) Start time of Final Application (local)

(m) Type I Gallons used

(n) Type II, III, IV (as applicable) gallons used if applied

(2) Retain locally for 30 days from the last aircraft deicing / anti-icing entry.

F. Type I, II, III, IV Fluid Receipt and Acceptance Record

(1) The Type I, II, III or IV Anti-icing Fluid Receipt and Acceptance Record will be completed by the local station at delivery and filed in the Local Station Acceptance Log to document fluid acceptability for use. The following items must be documented.

(a) Station

(b) Service Provider

(c) Date Received

(d) Product type (I, II, III or IV)

(e) Product Manufacture

(f) Product Brand Name

(g) Storage Tank Identification Number (totes / barrels enter unique identifier)

(h) Lot / Batch Number (ref CoA)

(i) Appearance (For bulk tanker deliveries only or if opening a tote or barrel)

(j) Refractive Index at 68°F (For bulk tanker deliveries only or if opening a tote or barrel)

(k) Employee Number

(2) Record results of New Delivery Check.

(3) Copies of the Certificate of Analysis (Conformance) are to be accessible (either on site or electronically from the manufacturer) for a minimum of 2 years. Retain this record and certificates for two years from the most recent entry.

(4) Totes / barrels are not required to be opened / tested upon delivery when the tote / barrel is sealed from the manufacturer. If not unsealing totes / barrels, record SEALED in appearance and refractive index fields.

NOTE: **Reference Chapter 3, paragraph 9.C. Deicing / Anti-icing fluids (Type I, II, III and IV) processing for specific requirements when other 121 carrier approved fluid receipt and acceptance training is utilized.**

G. Winter Operations Management Program (supplemental information)

(1) This will be the primary method for submitting station readiness plan.

(2) The Winter Operations Management program is an electronic application maintained for use by all United cold weather stations and includes the requirements as listed below for the Winter Operations Station plan.

(3) Winter Operations Management Program will contain the following information:

(a) Station identification - station code

(b) Station readiness date

(c) Deicing coordinator names

1 Have proper training certifications

(d) Primary and secondary deicing Service Providers, as applicable

(e) Fluid types and product names

(f) Deicing / anti-icing sites (gate, ramp, pad, etc.)

H. User Checks

(1) Deicer trucks require a daily user check when in service. The locally created log must meet the minimum company requirements on the Daily User Check List form.

(a) Transmission Items

(b) Electrical Items

(c) Body / Frame Items

(d) Fluid Heaters

(2) Fall Restraint Harnesses and Lanyard require an **annual** pre-season check. The locally created log must meet the minimum company requirements on the Harness / Lanyard Annual Check form. This is to be completed by the Qualified Instructor-Deicing Trainer.

(a) Employee Number

(b) Station

(c) Date

(d) Deicing Provider

(e) Unit Number

(f) Fail / Pass

(g) Comments

(3) Fall Restraint Harnesses and Lanyards require a **daily** user check when in service. The locally created log must meet the minimum company requirements on the Daily User Check List form.

(a) Station

(b) Deicing Provider

(c) Date

(d) Unit Number

(e) Pass / Fail

(f) Employee Number

(g) Retain daily check for 30 days and annual check for one season.

NOTE: **Deicing Providers may follow their own OSHA accepted program for Fall Restraint Harnesses and Lanyards.**

I. Station Self Observations

(1) The Station is required to complete a United Airlines Deicing Observation as a form of Quality Control.

(a) The observer cannot be part of the physical deicing process of the observed flight.

(b) When the deicing is outsourced to a third party, the organization responsible for the oversight may complete the self observation and must have the associated training to support this function.

(c) The observer may be from the third party provider but must have the associated training to support this function.

1 Must be certified operator, Qualified Instructor or Master Trainer to complete this.

(2) All observations are to be submitted into the Winter Operations Management Program. The items to be completed are as follows:

(a) Date

(b) Station

(c) How many trucks are used to deice this aircraft

(d) Flight

(e) Aircraft Registration Number

(f) Observer identification Name and United Employee Number

(g) 1 Step or 2 Step Application

(h) Fahrenheit or Celsius

(i) Outside Ambient Temperature

(j) Primary Unit Observed

(k) Fluid Applied (as listed on the plan)

(l) Freezing Point

(m) Fluid Temperature

(n) Mix Ratio when applicable

(o) The following questions must also be answered:

1 Was the aircraft free of contaminates?

2 Was a proper tactile check completed when applicable?

3 Was equipment planeside in sufficient time to avoid any delay?

4 Did any operator engage in risky behavior during the deicing process?

5 Was the aircraft deicing record completed correctly?

6 Was fluid applied per regulations?

7 Were fall protection equipment and processes used?

8 Was the training status valid for the operator of record?

9 If any above questions result in a failed response, local mitigation must be provided as part of the observation submission.

(p) Comments

(3) All observations are required to be submitted into the Winter Operations Management Program.

(a) All observation will be reviewed locally for mitigation if needed and reviewed by the CWOC for issue identification, mitigation and program enhancement.

(b) Reviewed and available on Winter Operations Management Program by the CWOC individually for:

1 Issue identification,

2 Mitigation and

3 Program enhancement.

(c) All recommendations will be forwarded to the Senior Vice President for program revision consideration.

(4) The station is required to complete and forward at minimum, one observation a month during the season based on their assigned target ready date.

(a) The observations will follow a monthly calendar. If the station ready date is halfway through the month (example: 15 OCT), an observation is expected by the end of October, and another by the end of November.

(b) The requirement for observations will end March 31.

(c) If no deicing events occur, no observation is required.

(5) Station De / Anti-icing Counts

(a) The Winter Operations Management Program requires each station to submit the total number of aircraft de / anti-iced. This can be found under the observation tab. This should be updated within seven days, at a minimum. If no deicing has taken place on a given day, enter zero for the day.

(b) The requirement for counts will end May 31. If any deicing is performed after May 31, counts must be updated to reflect number of aircraft deiced on day of deicing.

(c) Counts will resume with the season readiness date established for each location.

GLOSSARY

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	The section will list abbreviations, acronyms and define terms used in the industry and Aircraft Deicing / Anti-icing Program Manual.
Abbreviations	
ABM	Airport Business Manager
A/C	Aircraft
AC	Advisory Circular
ACARS	Aircraft Communications Addressing and Reporting System
AD	Airworthiness Directive
ADAP	Aircraft Deicing / Anti-icing Program
ADF	Aircraft Deicing Fluid
AFM	Aircraft Flight Manual
AMM	Aircraft Maintenance Manual
AO	Airport Operations
AOBM	Airport Operations Business Manual
AOA	Angle of Attack
APU	Auxiliary Power Unit
A4A	Airlines for America
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
C	Celsius
CAA	Civil Aviation Authority
CDF	Centralized Deicing Facility
CFR	Code of Federal Regulations
CMO	Certificate Management Office
CMFO	Certificate Management Field Office
CoA	Certificate of Analysis
CPO	Chief Pilot Office

CWOC	Corporate Winter Operations Committee
DC	Deicing Coordinator
EA	Engineering Authorization
EAI	Engine Anti-Ice
EASA	European Aviation Safety Agency
EC/RA	Engineering Change / Repair Authorization
EFB	Electronic Flight Bag
EG	Ethylene Glycol
EPA	Environmental Protection Agency
F	Fahrenheit
F/O	First Officer
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBO	Fixed Base Operator
FOM	Flight Operations Manual
FP	Freezing Point
FPA	Flight Planning Area
FSAT	Federal Flight Standards Bulletin for Air Transportation
GM	General Manager
GMM	General Maintenance Manual
GCSD	Global Customer Service Design
HOT	Holdover Time
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INOP	Inoperative
IOSA	IATA Operational Safety Audit
ISO	International Standards Organization
JAA	Joint Aviation Authority

Jepps	Jeppesen
KIAS	Knots Indicated Air Speed
LAN	Local Area Network
LOUT	Lowest Operational Use Temperature
LPC	Low Pressure Compressor
METAR	FAA defined as *aviation routine weather report*
N/A	Not Applicable
NOC	Network Operations Center
OAT	Outside Air Temperature
OFP	Operational Flight Plan
OPC	Operational Person in Charge
Op Spec	Operational Specification (airline)
PCC	Pre-Takeoff Contamination Check
PG	Propylene Glycol
PIC	Pilot in Command
PMI	Principle Maintenance Inspector
POI	Principle Operations Inspector
PPE	Personal Protective Equipment
QID	Qualified Instructor Deicing
RON	Remain Over Night
SAE	Society of Automotive Engineers
SAMC	System Aircraft Maintenance Control
SDS	Safety Data Sheets
SHARES	Shared Reservation System
SOP	Standard Operating Procedure
TAT	Total Air Temperature
TBD	To Be Determined
TOMC	Technical Operations Maintenance Control

UA	United Airlines
VHF	Very High Frequency
VR	Vertical Rotation
WSI	Weather Services International
Weather Abbreviations	
DWPNT	Dew Point
DRZL	Drizzle
FG	Fog
FZDZ	Freezing Drizzle
FZFG	Freezing Fog
FZRA	Freezing Rain
IP	Ice Pellets
KT(s)	Knot(s)
RA	Rain
RH	Relative Humidity
SNW	Snow
SP	Snow Pellets, grains, graupel
WND	Wind
WX	Weather
Definitions	
Allowance Times	Time defined within the IP duration period.
Anti-Icing	When freezing precipitation conditions exist or are anticipated to exist prior to takeoff, a two-step deicing / anti-icing procedure is used. The first step, deicing, is the removal of contaminants from the aircraft. The second step, anti-icing, is a separate fluid application to protect against future accumulations of contaminants from adhering to critical aircraft surfaces.
Auxiliary Power Unit	A gas turbine engine intended for use as a power source for driving generators, hydraulic pumps, and other airplane accessories and equipment and / or to provide compressed air for airplane pneumatic systems.
Buffer	The difference between the outside air temperature and the freeze point of the deicing / anti-icing fluid.

Clean Aircraft Concept	Term used which requires a post deicing / anti-icing inspection to confirm that critical aircraft surfaces are “clean” (free of adhering frost, ice, snow, or slush) and to determine that any contaminants not adhering to critical surfaces will blow off during early stages of the takeoff roll.
Clear Ice	Ice that is smooth and generally follows the contours of the surface closely, although after some accumulation, it can form ridges.
Cold Soaked Wing Frost	Frost caused by cold soaked fuel in the wing tanks. Frost will form on very localized surfaces of the wing in the area of the fuel tanks even when ambient air temperature is well above freezing. Up to 3mm (1/8 inch) under the wing is permissible for takeoff. In this condition, clear ice streams or rivulets are not permitted.
Deicing	A procedure by which frozen contamination is removed from the aircraft in order to provide clean surfaces. When freezing precipitation conditions do not exist and are not anticipated, a one-step deicing procedure is used to remove any contaminants that may have adhered to the aircraft during a previous exposure to freezing precipitation. This step is accomplished using appropriate deicing fluids.
Deicing / Anti-Icing	A combination of the deicing and anti-icing procedures that may be performed in one or two steps.
Environmental Frost	Frost caused by weather conditions. This usually occurs overnight or during early morning hours and is of very short duration. Frost may form on numerous aircraft surfaces. A thin coating of frost is permitted on the fuselage only (including on center engine aircraft) if letter and paint lines are visible through the frost.
Freezing Drizzle	Fairly uniform precipitation composed exclusively of fine drops very close together. Drizzle appears to float while following air currents although, unlike fog, it falls to the ground and freezes on impact.
Freezing Fog	Clouds of super cooled water droplets that form a deposit of ice on objects in cold weather conditions. May also be referred to as ice fog.
Freezing Rain	Rain falling as very cold drops, which freeze on contact with objects.
Frost	A crystallized deposit, formed from water vapor on surfaces, which are at or below 0°C (32°F). Active frost conditions exist when crystals are growing and gaining in mass and thickness, this is considered a precipitation condition. It typically forms at night under clear skies and calm winds when the OAT is below 0°C (32°F) and the dew point temperature spread is less than 3°C (5°F). The temperature of the aircraft surface must be below 0°C (32°F).
Ground Personnel	Airport Operations, including Winter Operations Coordinators, Technical Operations or Contract Agency personnel providing deicing / anti-icing services.
Hoarfrost	Uniform white deposit of fine crystalline texture, which is thin enough to distinguish surface features underneath, such as paint lines, markings or lettering.
Holdover Time	The estimated time deicing / anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the critical surfaces of the aircraft. Holdover time begins when the final application of deicing / anti-icing fluid commences and expires when the deicing / anti-icing fluid loses its effectiveness.

Ice Pellets	Frozen water droplets, which may have sufficient mass to accumulate and impinge upon the layer of deicing / anti-icing fluid on aircraft surfaces. **Holdover times do not exist for this condition and a Cabin Check must be accomplished within five minutes of takeoff.**
Non-Certified Type I, II and IV Fluids	Deicing / Anti-Icing fluids that do not meet SAE / ISO certification requirements (including military fluids). These fluids may be encountered at certain international stations, or during off-line operations at military bases. Use of these fluids on Continental aircraft is not authorized for takeoff during active icing conditions. These fluids are to be used for deicing only.
One-Step Deicing / Anti-Icing	One-step (International only) deicing / anti-icing cleans the aircraft surfaces and protects those surfaces in one application of heated fluid.
Post Deicing Check	A check, after deicing application, to ensure all aircraft surfaces are free of frozen contaminants.
Pre-takeoff Check (Nose Check)	A check completed within the aircraft's HOT of the wings or representative surfaces for frozen contaminants.
Pre-takeoff Contamination Check (Wing Check)	A check conducted after the aircraft's HOT has been exceeded to ensure the aircraft's wings, control and other critical surfaces, as defined by this document are free of all frozen contaminants. This check must be completed from outside the aircraft a minimum of 5 minutes before beginning takeoff, unless procedures approved within this program designate.
Quiet Area	An area on the aircraft in which the air flow will not actively remove the fluid.
Rain on Cold Soaked Wings	Water droplets forming ice or frost on the upper wing surface when the temperature of the aircraft wing surface is at or below 0°C (32°F).
Refractive Index (RI)	Refractive index is a constant physical property related to the speed at which light can pass through a liquid solution. The denser the liquid, the slower light will travel through it and the higher its reading will be on a Refractometer. The index is temperature sensitive.
Secondary Service Provider (back up)	Another airline or service provider who is contracted to accomplish deicing / anti-icing operations in a back-up position in the case the primary provider cannot perform the duties.

Slush	Partially melted snow or ice that can be splashed on the fuselage or landing gear by the aircraft's wheels.
Snow	Precipitation in the form of small ice crystals or flakes, which may accumulate on, or adhere to, aircraft surfaces. A mixture of rain and snow is treated the same as freezing rain when determining holdover time, and takeoff is authorized only during light conditions.
Snowflake	Winter Operations trained personnel staffed by the Chief Pilots Office (or CPO representative) at each hub (CLE, DEN, EWR, IAD, IAH & ORD) to assist the Pilot in command (PIC) with feedback on conditions external to their aircraft in order to improve the safety of the operations.
Snow Grains	Frozen water droplets, which may have sufficient mass to accumulate and impinge upon the layer of deicing / anti-icing fluid on aircraft surfaces. **Holdover times do not exist for this condition and a Cabin Check must be accomplished within five minutes of takeoff.**
Snow Pellets	Frozen water droplets, which may have sufficient mass to accumulate and impinge upon the layer of deicing / anti-icing fluid on aircraft surfaces. **Holdover times do not exist for this condition and a Cabin Check must be accomplished within five minutes of takeoff.**
Two-Step Deicing / Anti-Icing	Deicing / Anti-Icing consisting of two distinct steps. The first step (deicing) is followed by a second step (anti-icing) as a separate fluid application. Anti-Icing fluid is applied to protect the relevant surfaces, thus providing maximum possible anti-ice capability.
Type I Fluid	Non-thickened fluids that form very thin wetting films on aircraft surfaces. These fluids are red, red-orange or orange in color, except in Japan where they are clear.
Type II Fluid	Thickened fluids which decrease in viscosity when subjected to shear forces during the take-off roll. They contain a minimum of 50% glycol. Most fluids are clear or pale straw colored.
Type III Fluid	Thickened fluids which decrease in viscosity when subjected to shear forces during the take-off roll. They contain a minimum of 50% glycol. Most fluids are clear or pale straw colored.
Type IV Fluid	Enhanced performance fluids with characteristics similar to Type II when used in 100% concentration during certain weather conditions. Type IV fluid effectiveness is superior to Type II fluids and holdover time is increased by a significant factor under most conditions. These fluids are green in color, except in Japan where they are clear.

STANDARDIZED INTERNATIONAL AIRCRAFT GROUND DEICING PROGRAM (SIAGDP)

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FAA 14 CFR Part 121 Standardized International Aircraft Ground Deicing Program (SIAGDP)

Executive Summary

July 1, 2023

The Standardized International Aircraft Ground Deicing Program (SIAGDP) allows participating U.S. 14 CFR Part 121 operators a shared approved, compliant and standardized program to operate in international locations.

The core of this program is the De/Anti-icing Vendor Audit (DEVA).

At locations shared by participating airlines, a pooling of audit results is acceptable. For this to occur, specific information must be gathered and provided to the members for access to their own program.

The FAA 14 CFR Part 121 air carriers participating in this program do so to fulfill the air carriers' internal Quality Control program requirements for continuous surveillance of the vendors under contract to perform de/anti-icing services and requirements of the SIAGDP. The most current version of SAE AS6285, AS6286 and AS6332 are recognized as the official international standards and are used in conjunction with the SIAGDP.

Participating air carriers (listed) submit that each will comply to conduct audits using the DEVA Checklist, review results, submit results to the A4A host for posting each location for which the corresponding airline is individually responsible. Audits will be conducted according to SAE Aerospace Standards AS6285, AS6286 and AS6332.

The Airlines For America (A4A) will host the data repository where each participating airline will submit:

1. List of designated auditors
2. Schedule of planned audits
3. DEVA results, including date of the audit conducted
4. Corrective action responses including acceptance or rejection of location

NOTE: If an in-person DEVA audit is not possible at a particular location due to government, airport or airline restrictions a desktop audit can be performed with participating airlines approval.

Participating FAA 14 CFR Part 121 Air Carriers are: American Airlines, Alaska Airlines, Delta Airlines, FedEx Express, Horizon Air, SkyWest Airlines, United Airlines, JetBlue and UPS Airlines.