DEICE ANTI-ICE OPERATIONS MANUAL

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Abbreviations

ABBREVIATION	DESCRIPTION
ADF	Aircraft Deicing Fluid
AOM	Aircraft Operations Manual
APU	Auxiliary Power Unit
ASOS	Automated Surface Observing System
ATIS	Automatic Terminal Information Service
CFR	Code of Federal Regulations
EPR	Engine Pressure Ratio
FAA	Federal Aviation Administration
FAS	Forced Air System
FOD	Foreign Object Damage
FPD	Freeze Point Depressant Deice Fluids
HOT	Holdover Time
IAEP	Internal Audit Evaluation Program
LOUT	Lowest Operational Use Temperature
METAR	Meteorological Aerodrome Report
NTSB	National Transportation Safety Board
OAT	Outside Air Temperature
PIC	Pilot In Command
RVR	Runway Visual Range
SMS PRO	Safety Management System Reporting Software

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Chapter 0 - ORGANIZATION RESPONSIBILITIES

0.1 Organization Responsibilities

A. **Director, Flight Operations** (119 FAA Position) - Responsible for developing the Deicing/Anti-icing Program to comply with 14 CFR 121.629, ensuring company personnel are properly trained and company manuals provide guidance to personnel involved during operations in icing conditions. Ensuring Deice Audits are in place as outlined in IAEP and SMS PRO. Responsible for the overall deice/anti-ice operation.

B. **Manager, Flight Standards & Training** - Responsible for providing Deice/Anti-ice Training for all Flight Crewmembers and Dispatchers.

C. **Supervisor, Flight Operations Technical Programs** - Responsible for ensuring compliance of the Deice/Anti-ice Training for Flight Crews and Dispatchers is accomplished.

D. **Director, Line Maintenance** - Responsible for providing/arranging aircraft deicing for all stations with/without ABX Air Maintenance Deice Personnel.

E. **Deice Operations Manager** - Responsible for overseeing ABX deicing operations. Recommends distribution of ABX Air Deicing/Anti-Icing Training. Audits Deice Vendors. Reports to Director, Operations.

F. **Deicing Training Designee** - Responsible for Deice Personnel training and records. Reports to Director, Operations.

G. **Dispatch Shift Supervisor** - Responsible for reviewing weather conditions at outstations, and alerting appropriate personnel when conditions are conducive to icing.

H. **Manager, Airport Affairs** - Obtains Contract Deicing Vendors and agreements.

I. **Pilot-in-Command** - Responsible for safety of the flight, crew, cargo, and aircraft. In addition, PIC is responsible for:

1. Ensuring that the preflight inspection **(Preflight External Icing Check)** (See FODPM Ch 1.7 (C) of the aircraft's critical surfaces has been accomplished.

2. Insuring that the aircraft's critical surfaces are free from adhering frost, snow, ice, or any adhering frozen contamination. (Crew Deice Report)

3. Overseeing the deicing/anti-icing process at stations without ABX Air Qualified Deice Personnel, including determining the type, kind, and mixture of the deicing fluid and when the anti-ice application was started.

4. Ensuring that a **Pretakeoff Check** is accomplished by a Flight Crewmember or, if necessary, Qualified Deice Personnel (remote operations or tactile inspections) after the deicing/anti-icing process.

5. Ensuring that a **Pretakeoff Contamination Check** is accomplished by a Flight Crewmember or, if necessary, by Qualified Deice Personnel (remote operations or tactile inspections) if the holdover times has expired.

NOTE

Pretakeoff and Pretakeoff Contamination Checks are normally accomplished by the Flight Crew.

NOTE

The Captain has final authority for De/Anti-icing the Aircraft (See FOM Chapter 8.1)

6. Contact:

   ABX Air, Inc. Building 2062 ILN 145 Hunter Drive Wilmington Air Park Wilmington, OH 45177 Attn: Kent Stewart Email: Kent.stewart@lgstx.com

Chapter 1 - DEICING GENERAL

[Ref. GRH 4.2.1, GRH 4.2.2 & GRH 4.2.3-Entire Manual] (IOSA Audit Ground Handling Reference for Deicing/Anti-Icing.)

1.1 General

A. ABX Air, Inc.'s Aircraft Deicing/Anti-icing program is developed to provide satisfactory and specific means by which to fulfill the requirements of ensuring the "clean aircraft concept" is uniformly and judiciously exercised in all our flight operations. This program provides definition and necessary guidance to fulfill the requirements set forth in 14 CFR Part 121.629 and Operational Specification A023.

1. 14 CFR 91.527 states that "no pilot may take off an aircraft that has:

   a. Frost, snow, or ice adhering to any propeller, windshield, or powerplant installation or to an airspeed, altimeter, rate of climb, or flight attitude instrument system.

   b. Frost, snow or ice adhering to the wings, stabilizers or control surfaces."

2. 14 CFR 121.629 (b) states in part that "No person may take off an aircraft when frost, ice, or snow is adhering to the wings, control surfaces, propellers, engine inlets, or other critical surfaces of the aircraft."

3. This is known in the aviation industry as the "clean aircraft concept".

   a. Ensuring that the aircraft is free from any frozen contamination is the objective of the deicing/anti-icing program.

   b. 14 CFR 121.629 and Advisory Circulars 120-60-B, Link to (AC) 120-60B 20-117 Link to (AC) 120-117 and 120-58 Link to (AC) 120-58, Notice 2024-2025 N8900-708 https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/deicing Revised FAA-Approved Deicing Program Updates, Winter 2024-2025 provide guidance for ABX Air deice/anti-ice program and establishes provisions for complying with the "clean aircraft concept".

B. ABX Air, Inc. is based out of KILN and a large number of its aircraft fly in and out of KCVG/KILN for DHL and Amazon.

1. Initially each deice operator will complete the ABX Air deice training and at the start of each deice season thereafter. Or ABX may accept the deice providers training program.

C. General Information

1. This book contains information common to all ABX Air Deicing/Anti-icing training conducted by Flight, Maintenance, and Contract Personnel. This program references the Internal Audit and Evaluation Program (IAEP) manual for evaluating the deice programs process. These controls ensure ABX policies, procedures and controls for the Deice/Anti-ice program are followed and, desired results are achieved. Topics common to all personnel involved in deicing include:

   a. Deicing Program Background (Examples of deicing related accidents)

   b. Effects of frost, ice, snow and slush on aircraft surfaces

   c. Organizational responsibilities

d. Definitions

e. Types of freezing precipitation

f. Deice/Anti-Ice Procedures

g. Critical aircraft surfaces

D. Deicing Program Background

1. According to information received by the National Transportation Safety Board (NTSB) in 1992. In the 23 years prior to 1992 there have been 15 accidents related to the failure to deice aircraft adequately before takeoff. Major accidents, at least partially caused by the failure of ground deicing and considered to be a contributing factor are:

Date	Aircraft Type	Location	Precipitation/ Observations
27 DEC 68	DC-9-10	Sioux City	Light freezing drizzle
26 JAN 74	F28	Turkey	Probable cause: Frost accretion on wings
3 JAN 77	DC-8-62	Anchorage	Fog
4 JAN 77	B737	Frankfurt	Light snow, rime ice on wing
27 NOV 78	DC-9-10	Newark	Blowing rain and snow
12 FEB 79	Nord 262	Clarksburg	Light snow
18 FEB 80	Bristol 253	Boston	Light snow
13 Jan 82	B737	Wash D.C.	Moderate/heavy snow
5 Feb 85	DC-9-10	Philadelphia	Light freezing rain, ice and snow pellets, fog
12 Dec 85	DC-8-63	Gander, NF	Light freezing drizzle, snow grains
15 Nov 87	DC-9-10	Denver	Moderate snow, fog
10 Mar 89	F28	Dryden	Heavy snow
10 Mar 89	F28	Kimpo	Dense fog, ice on wing
16 Feb 91	DC-9-10	Cleveland	Light snow
22 Mar 92	F28	Flushing, NY	Light snow, fog

2. To address deficiencies in determining the air worthiness of aircraft in icing conditions, the FAA initiated an effort to resolve ground deicing issues for the winter of 1992/93. The result of that effort is a requirement for all 121 carriers to train personnel involved with deicing in the following subjects:

a. Effects of frost, ice, snow and slush on aircraft performance, stability, and control.

b. Basic characteristics of aircraft deicing/anti-icing fluids.

c. General deicing techniques for removing deposits of frost, ice, slush, and snow from aircraft surfaces, and techniques for anti-icing.

d. Deicing/anti-icing procedures in general and specific measures to be performed on different aircraft types.

e. Quality control procedures.

f. Deicing/anti-icing equipment operating procedures.

g. Safety precautions.

h. Emergency procedures.

i. Limitations of holdover time tables.

j. Deicing/anti-icing codes and communications procedures.

k. Special provisions and procedures for contract deicing/anti-icing (if applicable).

E. This document, in conjunction with efforts by the Flight, and the Maintenance Departments of ABX Air, Inc. establishes an in-house training program that reduces the chances of an aircraft accident due to flawed deicing/anti-icing procedures. Elements as they pertain to Flight, Maintenance personnel and contract deice providers are found in Chapters throughout this document and the applicable appendices.

F. Effects of Frost, Ice, Snow and Slush on Aircraft Performance

1. Icing contamination in the form of frost, snow, or ice on the critical surfaces can have disastrous effects on control of the aircraft. These effects include:

a. Increased drag and weight.

b. Rapid pitch up or wing roll off on rotation.

c. Loss of lift.

d. Stall at lower than normal angle of attack.

e. Wing buffet or stall before stall warning activation.

f. Decreased effectiveness of flight controls.

g. Engine foreign object damage (FOD).

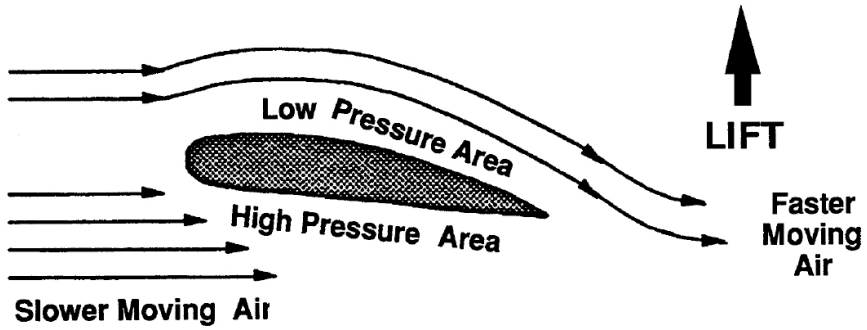
h. Ram air intakes.

i. Instrument pickup points.

2. Lift Versus Drag.

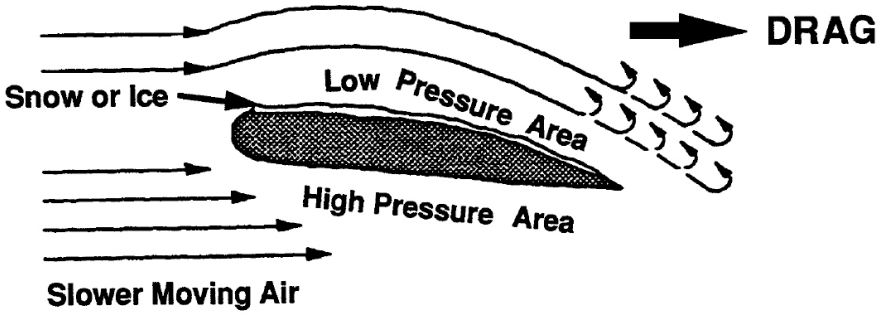
a. The shape of the wing is designed so that the airflow is directed over the width of the wing creating opposing areas of pressure (low and high), these opposing forces create lift.

Figure 1-1, How a Wing Produces Lift



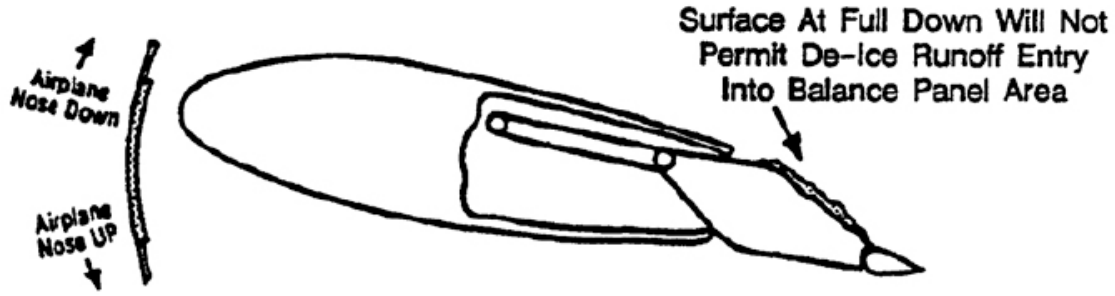
b. Snow, ice or frost accumulations on wing surfaces disrupt airflow. This adds to drag instead of lift and makes it much more difficult for the aircraft to fly.

Figure 1-2, How Contamination Creates Drag

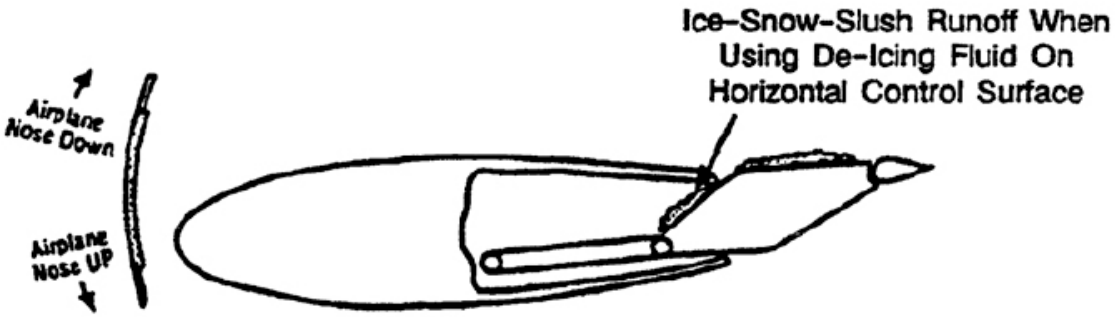


c. Ice and snow contaminates on control surfaces can cause improper airflow resulting in the loss of lift on the wings, stabilizers, and control structures. Even small amounts of snow or ice add weight beyond the limits of an aircraft's design. The reduced lift and increased weight combine to create a potential disaster.

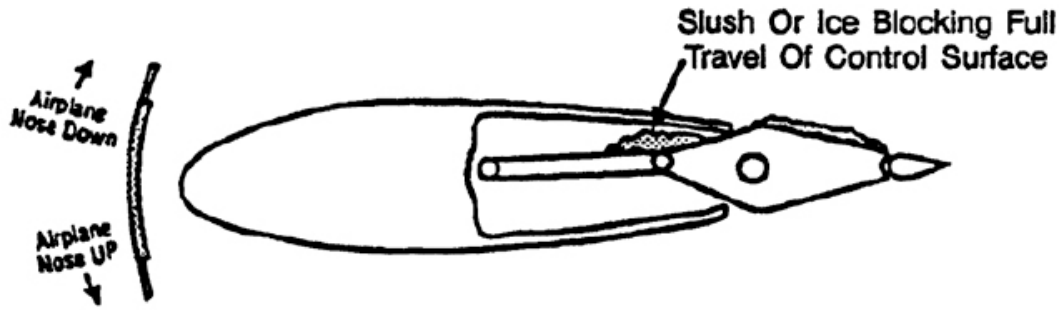
Figure 1-3 Horizontal Stabilizer Position



Recommended Position Of Horizontal Stabilizer During De-Icing Operations



De-Icing Slush Runoff Into Balance Panel Cavity



NOTE

If melted snow and ice are forced into the control surface hinge points or balance bay areas it could refreeze after takeoff and block the movement of the control surfaces, flaps and slats. This greatly limit the Pilot's ability to control the aircraft.

G. Icing Conditions

1. Airframe icing conditions are considered to be present when the aircraft's skin temperature is below freezing and high humidity or visible moisture is present.

2. Engine icing conditions are considered to be present when the temperature is 10°C (50°F) or below for the B-767 and either:

   a. Temperature/ dew point spread is less than 3°C (5°F)

      or

   b. Visible moisture is present -(falling precipitation)

      B767 - visibility less than 1 mile)

      B767 - (RVR less than 5000 ft.)

      or

   c. Wet ramps, taxiways and/or runways.

H. Types of Frozen Contaminates

1. Dry Snow

   a. Snow with limited water content that will fly into a cloud and dissipate rapidly when kicked.

   b. Outside air temperatures is usually below -2° C, but dry snow will become "wet" when exposed to bright sun.

2. Wet Snow

   a. Snow with enough water content that it will pack when stamped with foot, but does not splash.

   b. If snow splashes when stamped with foot, consider it slush.

3. Snow Grains

   a. Precipitation of very small white and opaque grains of ice. These grains are fairly flat or elongated; their diameter is less than 1 mm (0.04 in.). When the grains hit hard ground, they do not bounce or shatter.

4. Ice Pellets & Small Hail

   a. Precipitation of transparent or translucent pellets of ice, which are round or irregular, rarely conical, and which have a diameter of 0.2 inch (5 mm), or less.

   b. Guidance on Hail and Small Hail. The meteorological conditions "hail" and "small hail" are not equivalent. No holdover times exist for either of these conditions; however, it has been determined that small hail is meteorologically equivalent to moderate ice pellets and therefore moderate ice pellet allowance times can be used in small hail conditions.

5. Slush

   a. Partially melted snow with high water content.

b. Will splash when stamped with foot or if a vehicle runs though it.

6. Frost

a. Forms near the surface in clear stable air with light winds with temperatures less than 0° C.

b. Does not change the basic aerodynamic shape of the airfoil, but causes drag and up to a 5 to 10% increase in stall speed.

7. Freezing Rain/Drizzle

a. Supercooled water droplets that freeze upon impact with aircraft surfaces.

b. Can form rapidly, forming clear ice that increases drag and decreases lift.

8. Freezing Fog

a. Supercooled water vapor that will freeze to aircraft surfaces as the airfoil moves through the air and disturbs the water vapor.

9. Rain On A Cold Soaked Wing

a. Ice may form on wing due to supercooled fuel from aircraft operations at high altitudes.

b. Ice can form at temperatures as high as 21° C in high humidity.

10. Unknown Precipitation.

a. Precipitation type that is reported if the automated station (ASOS) detects the occurrence of light precipitation but the precipitation discriminator cannot recognize the type.

1.2 Procedures Flow Charts

A. The procedures flow chart is a logical flow for airframe deicing procedure. Reference Flow Chart, Figure 1-5, Deice/Anti-Ice Procedures Flow Chart.

B. Conditions Conducive To Aircraft Icing

1. Airframe icing conditions are considered to be present when the aircraft's skin temperature is below freezing and high humidity or visible moisture is present.

C. Are Critical Surfaces Free Of Frozen Contaminants - Yes

1. The PIC will base the decision to deice on the actual aircraft condition determined during the exterior preflight.

2. If the aircraft is found to be free of any frozen contamination during the (**Preflight External Aircraft Icing Check**), the aircraft may depart without deicing.

D. Are Critical Surfaces Free Of Frozen Contaminants - No

1. If the aircraft is found to be contaminated with any frozen contamination, the aircraft must be deice/anti-iced.

NOTE

Fuselage frost and up to 1/8" of underwing frost does not need to be removed.

E. Accomplish Deicing/Anti-icing Procedure

1. Deicing/Anti-icing is a two step process that consists of:

   a. Step 1. Deicing with a fluid mixture of water/glycol heated to at least 60°C (140°F) at the applying nozzle.

   b. Step 2. An anti-ice application of heated Type I with a freeze point of at least 10°C below the OAT, or a freeze point of at least 7°C below the OAT for thicken fluids such as Type II, III & IV.

F. Establish Appropriate Holdover Time [GRH 4.2.5].

1. The holdover time starts when the anti-ice application begins. The Crew Deice Report must be written or verbally communicated to the Flight Crew of the aircraft being deiced. The Qualified Deice Personnel, Out Based Vendors, and Line Station Maintenance Representatives will inform the Flight Crew of the following information: first, identify customer name and tail number; second, the type of fluid (for Types II and IV Fluids, the specific manufacturer name and Type fluid, or SAE Type II, SAE Type III, or SAE Type IV) with the mixture when using Type II, Type III, and Type IV Fluids for anti-ice application; third, the time the anti-ice application began and a statement to verify that the "aircraft is clean".

NOTE

When reporting type fluid for anti-ice using Type II, Type III, and Type IV Fluids, report Type and Mixture.

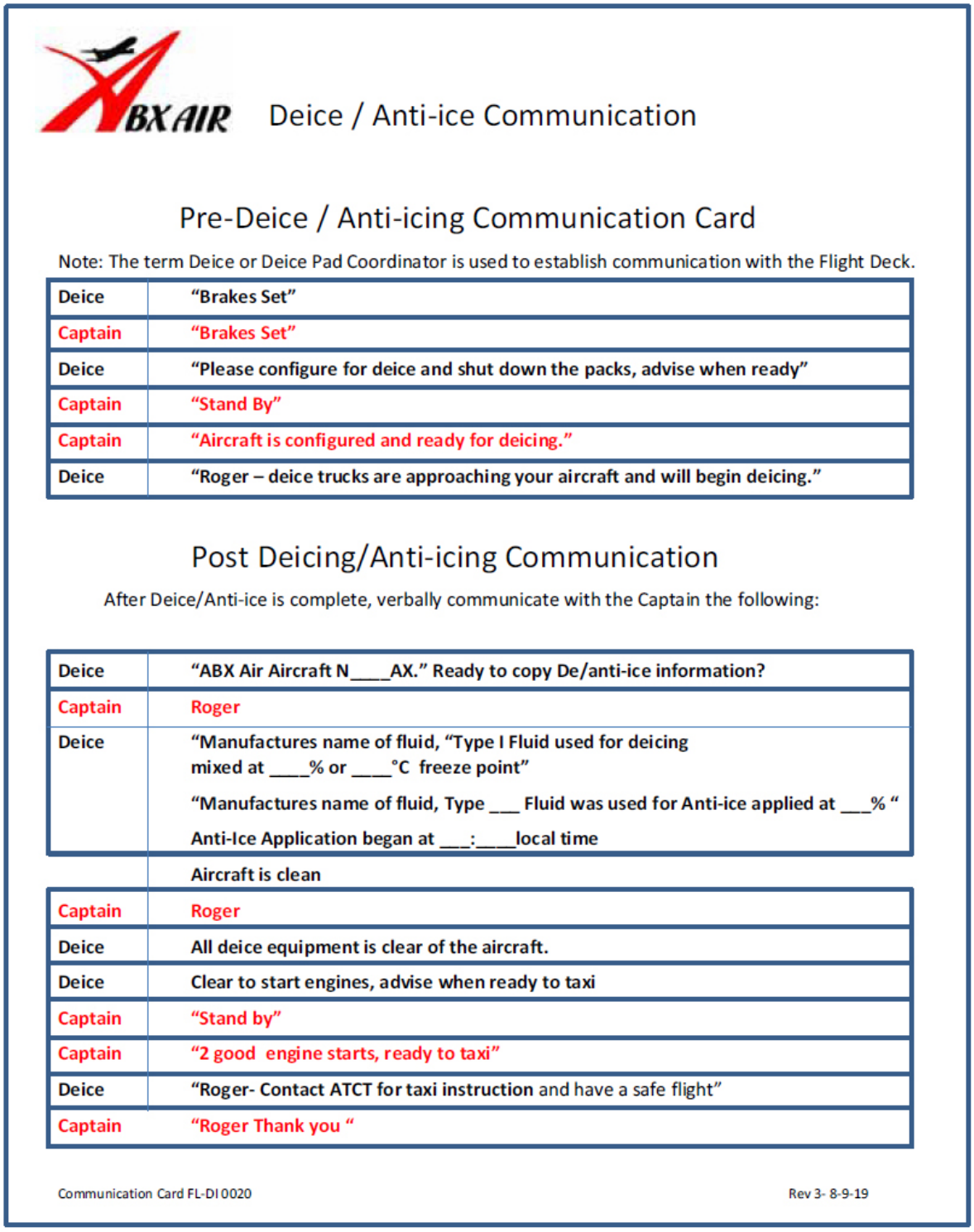
EXAMPLE: Using Type I Fluid for verbal communication via headset or aircraft radio frequency, state *"ABX Air aircraft 784AX, Type I Propylene, the anti-ice application began at 04:35, aircraft is clean." Deice equipment clear of the aircraft.*

EXAMPLE: Using Type IV fluid for verbal communication via headset or aircraft radio frequency, state *"ABX Air aircraft 784AX, "SAE Type IV" Type IV Propylene, mixture 100%, the anti-ice application began at 04:35, aircraft is clean." Deice equipment clear of the aircraft.*

G. Deice/Anti-ice Communication Card:

1. Print and use the following Communication Card to assist in giving the Crew Deice Report when using a headset or radio on a deice pad scenario when communicating to the Flight Deck during the deice process. Reference, Chapter 1, Figure 1-4.

Figure 1-4, Deice/Anti-ice Communication Card



ABX AIR Deice / Anti-ice Communication

Pre-Deice / Anti-icing Communication Card

Note: The term Deice or Deice Pad Coordinator is used to establish communication with the Flight Deck.

Deice	"Brakes Set"
Captain	"Brakes Set"
Deice	"Please configure for deice and shut down the packs, advise when ready"
Captain	"Stand By"
Captain	"Aircraft is configured and ready for deicing."
Deice	"Roger – deice trucks are approaching your aircraft and will begin deicing."

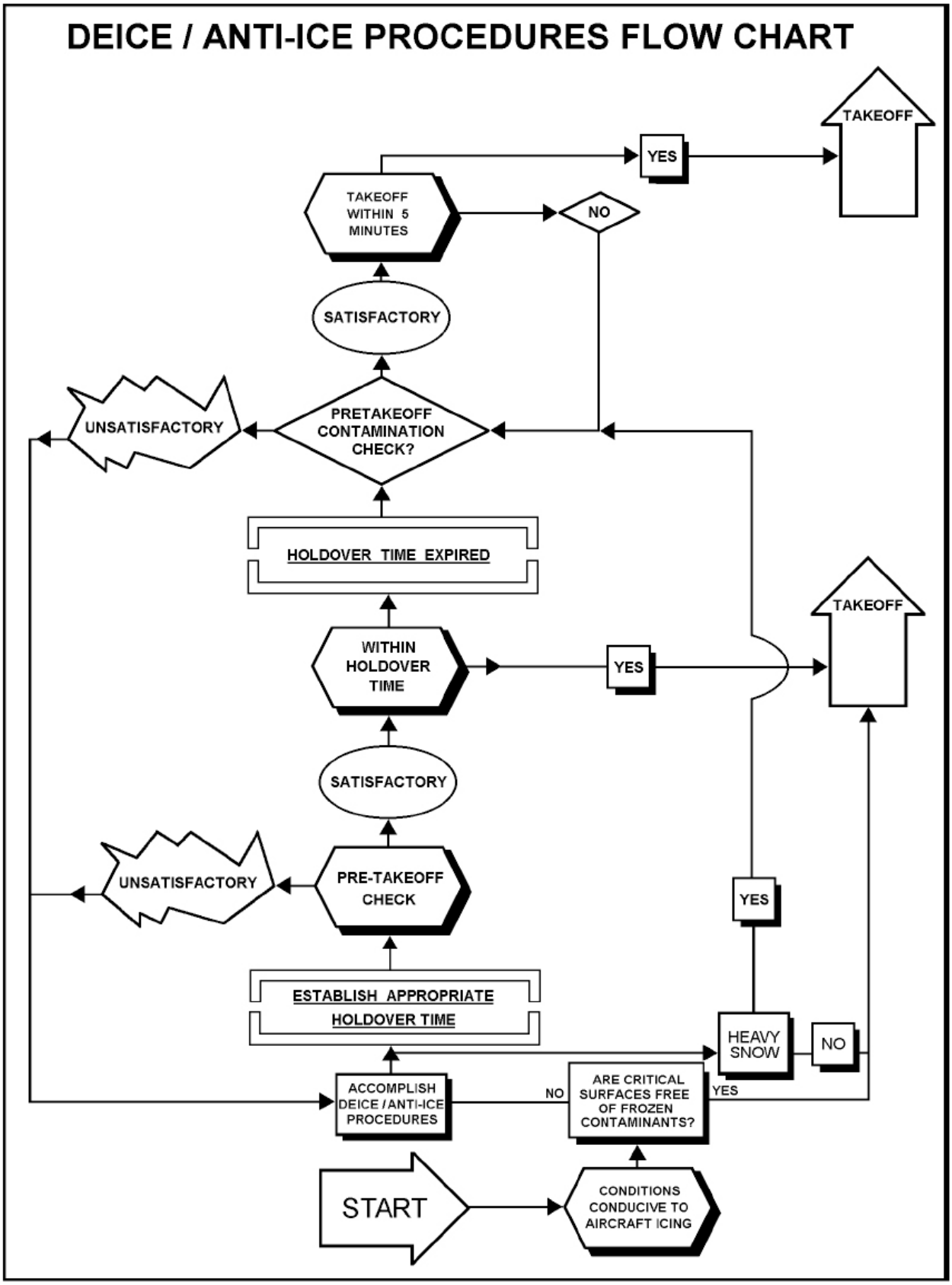
Post Deicing/Anti-icing Communication

After Deice/Anti-ice is complete, verbally communicate with the Captain the following:

Deice	"ABX Air Aircraft N____AX." Ready to copy De/anti-ice information?
Captain	Roger
Deice	"Manufactures name of fluid, "Type I Fluid used for deicing mixed at ____% or ____°C freeze point" "Manufactures name of fluid, Type ___ Fluid was used for Anti-ice applied at ___% " Anti-Ice Application began at ___:____local time
	Aircraft is clean
Captain	Roger
Deice	All deice equipment is clear of the aircraft.
Deice	Clear to start engines, advise when ready to taxi
Captain	"Stand by"
Captain	"2 good engine starts, ready to taxi"
Deice	"Roger- Contact ATCT for taxi instruction and have a safe flight"
Captain	"Roger Thank you "

Communication Card FL-DI 0020 Rev 3- 8-9-19

Figure 1-5 Deice/Anti-Ice Procedures Flow Chart



H. Pretakeoff Check - Satisfactory

1. The **Pretakeoff Check** will be performed after the deicing/antiicing procedure, but before the holdover time expires.

2. The **Pretakeoff Check** is normally performed by the Flight Crew from the cockpit windows or entry door, or if necessary can be performed by Qualified Deice Personnel during remote operations or Tactile Inspections.

3. For the Pretakeoff Check the Flight Crew will inspect the **representative surfaces** of the aircraft to ensure that the anti-ice fluid is still effective.

4. The **representative surfaces** that may be viewed will include the wing leading edges and upper surfaces.

5. Use wing leading edge flood lights and nacelle lights at night to illuminate the **representative surfaces**.

6. Anti-iced surfaces should retain their glossy appearance with no accumulation of snow or ice apparent.

I. Within Holdover Time - Yes - Takeoff

1. Provided that the holdover time has not expired, the aircraft may depart without any further inspections.

J. Pretakeoff Check - Unsatisfactory

1. If the aircraft is found to have any frozen contamination adhering to the aircraft, the aircraft must be deiced and anti-iced again.

K. Holdover Time Expired

1. If holdover time has expired the Flight Crew must perform a **Pretakeoff Contamination Check** to ensure that the representative surfaces are free of any frozen contamination.

NOTE

If holdover time has expired, the aircraft does not necessarily need to be redeiced. The Pretakeoff Contamination Check will determine the need for additional deicing/anti-icing.

CAUTION

THE HOLDOVER TIME FOR ICE PELLETS CANNOT BE EXTENDED BY A PRETAKEOFF CONTAMINATION CHECK.

L. Pretakeoff Contamination Check-Satisfactory

1. The Flight Crew may inspect the **representative surfaces** of the aircraft to ensure that the anti-ice fluid is still effective.

2. The **representative surfaces** that may be viewed will include the wing leading edges and upper surfaces.

3. Use wing leading edge flood lights and nacelle lights at night to illuminate the **representative surfaces**.

4. Anti-iced surfaces should retain their glossy appearance with no accumulation of snow or ice apparent.

M. Pretakeoff Contamination Check - Unsatisfactory

1. If a **Pretakeoff Contamination Check** is unsatisfactory, the aircraft must be deiced/anti-iced again before the aircraft may takeoff.

2. After subsequent deicing/anti-icing, a new holdover time must be established and a **Pretakeoff Check** must be accomplished before takeoff.

N. Takeoff Within 5 Minutes - Yes

1. If the **Pretakeoff Contamination Check** is satisfactory, the aircraft must depart within 5 minutes to avoid having to perform additional checks.

O. Takeoff Within 5 Minutes - No

1. If the aircraft does not takeoff within 5 minutes, another **Pretakeoff Contamination Check** must be accomplished.

NOTE

With the exception of the holdover time for ice pellets, there is no limit to the number of Pretakeoff Contamination Checks that may be performed, as long as the Pretakeoff Contamination Checks are satisfactory (representative surfaces remain clear of any frozen contamination).

NOTE

Pretakeoff Contamination Checks must be performed for heavy snow conditions since there are no holdover times for those conditions.

Chapter 2 - DEICING DEFINITIONS

2.1 Definitions

ADF	**A**ircraft **D**eicing **F**luid
Aerodynamically Quiet Areas	Where there is little or no airflow to cause fluid shear to take place, deicing fluid remains on the aircraft in what are called aerodynamically quiet areas. These areas are generally wing roots flap wells, balance bays, rear spar areas or crevices.
Anti-icing	A precautionary procedure by which the application of anti-icing fluids provides protection against the formation of frost, ice, snow and/or slush on clean surfaces of the aircraft for a period of time (holdover time). Anti-Icing fluids are most often Type I, Type II, Type III, or Type IV.
ASOS	Automated Surface Observing System detects significant changes, disseminating hourly and special observations via the networks. Additionally, ASOS routinely and automatically provides computer-generated voice observations directly to aircraft in the vicinity of airports, using FAA ground-to-air radio. These messages are also available via a telephone dial-in port. ASOS observes, formats, archives and transmits observations automatically. ASOS transmits a special report when conditions exceed preselected weather element thresholds.
Crew Deice Report	A verbal or written report by Deicing Personnel to the operating Flight Crew of the type, kind, mixture of fluid/water, time the antiice application began and that the aircraft's critical surfaces are free of frozen contaminates. (i.e. "Type IV, 100%, Anti-ice time 03:27, Aircraft is clean").
Critical Surfaces	Those surfaces on the aircraft designated to be free of adhering snow, ice, frost or other frozen contamination prior to initiating takeoff.
Deice Pad	Deicing pad is a central deice facility that the aircraft will taxi to for deice/anti-ice. Typically the used deice fluid is collected and treated or recycled to continue to improve storm water runoff from the airport.
Deicing	A procedure in which frost, ice or snow is removed from the aircraft to ensure clean aircraft surfaces for the purpose of flight and to comply with the "clean aircraft concept". In general, this process uses hot fluid such as Type I Deicing Fluid.
ERD	(Engine Running Deice) Deicing/anti-icing an aircraft with the engines running.
ETA	Estimated Time of Arrival.
ETD	Estimated Time of Departure.
Forced Air Systems (FAS)	A high speed airstream that will blow off dry snow. FAS also can have type 1 deicing fluid injected into the airstream.
FPD	Freeze Point Depressant Deice Fluids
Holdover Charts	1. Charts that can be developed by the carrier for different weather conditions for determining holdover times. 2. The charts developed by the carrier cannot be less restrictive than the SAE developed charts the FAA has adopted.
HOT/Holdover Times	a. Estimated time that the application of anti-icing fluid can reasonably be expected to prevent the reformation of frost, ice and the accumulation of snow on the treated surface of an aircraft. b. Holdover times begin when the application of anti-icing fluid begins and expires when the time shown on holdover chart has elapsed.

(LOUT) Lowest Operational Use Temperature

Lowest Operational Use Temperature

At colder temperatures, deicing/anti-icing fluids become too thick to flow off aircraft properly during takeoff and/or their freezing point temperature is reached, and they are no longer able to keep aircraft surfaces from freezing in the Presence of active precipitation. The LOUT is the lowest temperature at which a fluid has been determined to flow off aircraft critical surfaces in an aerodynamically acceptable manner while maintaining the required freezing point buffer.

Mechanical Method

The removal of snow and ice from an aircraft using equipment such as a snowbroom, squeegee, rope or other approved economical method.

(OAT) Outside Air Temperature

Ambient outside temperature commonly measured in fahrenheit or celsius.

Packs

Air Conditioning System on some aircraft.

PIC

Pilot in Command

Post Deicing Check

An inspection normally performed by Qualified Deicing Personnel after the deicing process to determine that the aircraft is free of frozen contaminates prior to beginning the anti-icing application.

Pre-Treating

The removal of snow and ice from an aircraft prior to departure usually by the application of hot deicing fluid as required followed by the application of anti-icing fluid in anticipation of a cold weather icing event.

Pretakeoff Check

a. A visual inspection by the Flight Crew or when necessary, Qualified Deicing Personnel (remote operations or tactile inspections), of the representative surfaces of an aircraft after the application of anti-icing fluids to ensure that the representative surfaces are free from any frozen contamination.

b. Performed before the Hold Over Time has expired to ensure the clean aircraft concept and as near as practical prior to taking the active runway.

NOTE

The FAA does not approve takeoff in conditions of moderate or heavy freezing rain, heavy ice pellets, or hail. The FAA has developed allowance times and associated limitations for takeoff in light or moderate ice pellets, light ice pellets mixed with other forms of precipitation, and small hail, as listed in the ice pellet and small hail allowance times tables (refer to FAA HOT Guidelines, Allowance Times for SAE Type III Fluids, Allowance Times for SAE Type IV Ethylene Glycol (EG) fluids, and Allowance Times for SAE Type IV Propylene Glycol (PG) Fluids. Additionally, takeoff in heavy snow may be accomplished if the requirements for operating in this condition, described in subparagraph 8d, are met.

NOTE

In addition to the following the operations in heavy snow guidance in the FAA HOT Guidelines, the FAA Propulsion and Energy Section (AIR-624) has issued the following statement: "Turbine engine power run-up procedures are defined in the Aircraft Flight Manual (AFM)." AIR-624 recommends that operators consider performing more frequent engine power run ups when operating in heavy snow conditions.

Pretakeoff Contamination Check

A visual inspection of the representative surfaces by Flight Crew or when necessary, Qualified Deicing Personnel (remote operations or tactile inspections), after the holdover time has expired and prior to taking the active runway to determine if the critical surfaces of the aircraft are free from frozen contamination. This check must be completed within 5 minutes prior to the beginning of takeoff or another Pretakeoff Contamination Check must be accomplished. A Pretakeoff Contamination Check must be accomplished prior to takeoff during heavy snow conditions using only Type IV Anti-icing Fluid in 100% form.

NOTE

Pretakeoff and Pretakeoff Contamination Checks are normally accomplished by the Flight Crew.

Preflight External Aircraft Icing Check

An inspection during the external walkaround by the Flight Crew to determine if the aircraft's critical surfaces are free from any adhering frozen contamination and if deicing/anti-icing is required.

Qualified Deicing Personnel (Person)

A qualified person or personnel may be an ABX Air Ground or Maintenance Representative or a Contract Deice Provider who has satisfactorily completed ABX Air Deice Training for the purpose of unsupervised deicing/anti-icing. Reference Chapter 3.

Refractometer

Refractometer is an instrument use to measure the freeze point or Refractive Index of Deicing or Anti-icing fluids.

Remote Deice

Deicing aircraft out of gate, taxiing or tow an aircraft to a central deice pad or end of runway scenario.

Representative Surfaces

A surface which may be checked by the Flight Crew or when necessary, Qualified Deicing Personnel (remote operations or tactile inspections) for frozen contamination during **Pretakeoff** and **Pretakeoff Contamination Checks** and is **representative** of the aircraft's critical surfaces.

SAE

SAE International is a leading organization for Technical Standards for the aerospace industry. Aerospace SAE Standards are ISO equivalent. [GRH 4.2.4]

Shear

Thickened anti-ice fluids will shear or breakdown when force is applied such as the movement of air over the aircraft's surfaces.

Tactile Inspection

A hands on inspection by Qualified Deicing Personnel or by Flight Crew by actually touching the treated surface to confirm the surface is free of frozen contaminants.

Type I Fluid

Type I Fluid is a glycol-based fluid used for aircraft deicing and anti-icing. Type I fluid is heated to a minimum of 140°F/60°C to remove frozen contamination from the aircraft surfaces. Type I can be used for anti-ice on events such as Frost.

NOTE

FAA Type I Hot Guidelines are not approved for use with unheated Type I Fluid Mixtures.

Type II Fluid

Type II fluids are “pseudoplastic”, which means they contain a polymeric thickening agent to prevent their immediate flow off aircraft surfaces. Typically the fluid film will remain in place until the aircraft attains 100 knots or so (almost 200 km/h), at which point the viscosity breaks down due to shear stress. The high speeds required for viscosity breakdown means that this type of fluid is useful only for larger aircraft. The use of type II fluids is diminishing in favor of type IV. Type II fluids are generally light yellow in color.

Type III Fluid

Type III fluids can be thought of as a compromise between type I and type II fluids. They are intended for use on slower aircraft, with a rotation speed of less than 100 knots. Type III fluids are gaining acceptance in the regional and business aviation markets. Type III fluids are generally light yellow in color.

Type IV Fluid

Type IV fluids meet the same AMS standards as type II fluids, but they provide a longer holdover time. They are typically dyed green to aid in the application of a consistent layer of fluid.

Chapter 3 - DEICING PROCEDURES

3.1 General

A. After the Preflight External Aircraft Icing Check, the Captain will make the final determination to deice/anti-ice the aircraft if frost, snow, or ice is adhering to the aircraft's critical surfaces.

B. If, based on the Preflight External Aircraft Icing Check the critical surfaces are determined to be free from any adhering frozen contamination, the aircraft may depart without the application of deicing/ anti-icing fluids.

C. If the aircraft is inspected and the critical surfaces are determined to be contaminated with any adhering frozen contamination, then deicing/ anti-icing must be accomplished.

NOTE

Due to the cost of deicing fluids and environmental concerns about it's use, Flight Crews are encouraged to decline deicing if, and only **if, the aircraft's critical surfaces are free from any adhering frozen contamination.**

3.2 Deice/Anti-Ice fluids

A. Propylene or Ethylene glycol are used to deice/anti-ice the aircraft.

1. Type I fluid is heated to a minimum of 60°C (140°F) and can be used to deice and/or anti-ice the aircraft.

2. Type II, III, and IV Fluids Characteristics. Type II, III, and IV fluids are thickened, non-Newtonian fluids. A non-Newtonian fluid is one whereby the viscosity (thickness) decreases when a shearing force is applied, such as the airflow over aircraft surfaces on Takeoff. When applied to the aircraft surfaces, these fluids form an anti-icing thickness layer, which absorbs freezing or frozen contamination with the exception of ice pellets and small hail. Although thickened, Type III fluid is much thinner than Type II or IV fluids, a characteristic making it suitable for lower rotation speed aircraft, as well as those with sufficient rotation speeds to use type II or IV fluids.

3. HOTs for Types II, III, IV fluids are primarily a function of the OAT, precipitation type and intensity, and percent fluid concentration applied. The icing precipitation condition (e.g., frost, freezing drizzle, light freezing rain, and rain on a cold-soaked wing) applies solely to active meteorological conditions.

4. Type II, III, and IV fluids are used for anti-ice only. Anti-ice fluids are applied only to a clean aircraft surface. ABX Air policy requires Type I deicing fluid to be used prior to Type II, III, or IV anti-ice fluids application. This practice will help prevent Type II, III, or IV dry out issues from residues that can collect in aerodynamic quiet areas of the aircraft.

NOTE

Deicing/Anti-icing fluids do not provide any protection from contamination once the aircraft is airborne.

B. Type I fluid will be mixed to provide a freeze point buffer relative to the OAT.

1. At outstations, the Qualified Maintenance Representative or Qualified Deice Personnel will inform the Flight Crew of the type of fluid, the time the anti-ice application began and a statement that the "aircraft is clean".

2. The Qualified Deice personnel are responsible for checking and ensuring the mixture of the Type I fluid being applied is a adequate for the OAT.

3. When utilizing a Contract Deice Vendor, there may be occasions where the Captain of the flight must determine the type, kind and mixture of the deicing fluid and when the anti-ice application began.

Figure 3-1, Guidelines For The Application Of SAE Type I Fluid

Outside Air Temperature (OAT)[1]	One-Step Procedure De/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing[2]
0 °C (32 °F) and above	Heated mix of fluid and water with a freezing point of at least 10 °C (18 °F) below OAT	Heated water or a heated fluid/water mixture	Heated mix of fluid and water with a freezing point of at least 10 °C (18 °F) below OAT
Below 0 °C (32 °F) to LOUT		Heated fluid/water mixture with a freezing point at OAT or below	

NOTES

1 Fluids must not be used at temperatures below their lowest operational use temperature (LOUT).

2 To be applied before first-step fluid freezes, typically within 3 minutes. (This time may be higher than 3 minutes in some conditions, but potentially lower in heavy precipitation, colder temperatures, or for critical surfaces constructed of composite materials. If necessary, the second step shall be applied area by area.)

CAUTIONS

- This table is applicable for the use of Type I holdover time guidelines in all conditions, including active frost. If holdover times are not required, a temperature of 60 °C (140 °F) at the nozzle is desirable.
- If holdover times are required, the temperature of water or fluid/water mixtures shall be at least 60 °C (140 °F) at the nozzle. Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
- To use Type I Holdover Times Guidelines in all conditions including active frost, an additional minimum of 1 liter/m^2 (~2 gal./100 sq. ft.) of heated Type I fluid mixture must be applied to the surfaces after all frozen contamination is removed. This application is necessary to heat the surfaces, as heat contributes significantly to the Type I fluid holdover times. The required protection can be provided using a 1-step method by applying more fluid than is strictly needed to just remove all of the frozen contamination (the same additional amount stated above is required).
- The lowest operational use temperature (LOUT) for a given Type I fluid is the higher (warmer) of:
  a) The lowest temperature at which the fluid meets the aerodynamic acceptance test for a given aircraft type; or
  b) The actual freezing point of the fluid plus a freezing point buffer of 10 °C (18 °F).
- Wing skin temperatures may differ and, in some cases, be lower than the OAT. A stronger mix (more glycol) may be needed under these conditions.

C. Type II, III and IV fluids are a glycol-based fluid that have been thickened to allow for longer holdover times.

1. Type II, III and IV fluids may be in either 100%, form or in a 75% or 50% mixture with water.

2. SAE Type II, Type III and Type IV fluids may be used below -25°C provided the freezing point of the fluid is at least 7°C below the OAT and the aerodynamic acceptance criteria are met. Consider use of Type I fluid when SAE Type II, Type III and Type IV fluid cannot be used.

3. Type II, Type III and Type IV fluids require speeds of 100 knots to shear the fluid from the leading edge and wing upper surface.

4. Type II, III and IV fluids may remain in stagnate airflow areas (i.e. flap wells, etc.).

Figure 3-2, Guidelines For The Application Of SAE Type II and IV Fluid

GUIDELINES FOR THE APPLICATION OF SAE TYPE II AND IV FLUID

(FLUID CONCENTRATIONS IN % VOLUME)

Outside Air Temperature (OAT)[1]	One-Step Procedure De/Anti-icing	Two-Step Procedure	
		First Step: Deicing	Second Step: Anti-icing[2]
0 °C (32 °F) and above	100/0, 75/25 or 50/50 Heated[3] Type II or IV fluid/water mixture	Heated water or a heated Type I, II, III, or IV fluid/water mixture	100/0, 75/25 or 50/50 Heated or unheated Type II or IV fluid/water mixture
Below 0 °C (32 °F) to -3 °C (27 °F)	100/0, 75/25 or 50/50 Heated[3] Type II or IV fluid/water mixture	Heated Type I, II, III, or IV fluid/water mixture with a freezing point at OAT or below	100/0, 75/25 or 50/50 Heated or unheated Type II or IV fluid/water mixture
Below -3 °C (27 °F) to -14 °C (7 °F)	100/0 or 75/25 Heated[3] Type II or IV fluid/water mixture	Heated Type I, II, III, or IV fluid/water mixture with a freezing point at OAT or below	100/0 or 75/25 Heated or unheated Type II or IV fluid/water mixture
Below -14 °C (7 °F) to LOUT	100/0 Heated[3] Type II or IV fluid/water mixture	Heated Type I, II, III, or IV fluid/water mixture with a freezing point at OAT or below	100/0 Heated or unheated Type II or IV fluid/water mixture

NOTES

1 One step or second step fluids must not be used at temperatures below their lowest operational use temperature (LOUT). First step fluids must not be used below their freezing points. Consideration should be given to the use of Type I/III fluid when Type II/IV fluid cannot be used due to LOUT limitations (see Table 45, 47, 48). The LOUT for a given Type II/IV fluid is the higher (warmer) of:

   a) The lowest temperature at which the fluid meets the aerodynamic acceptance test for a given aircraft type; or
   b) The actual freezing point of the fluid plus its freezing point buffer of 7 °C (13 °F).

2 To be applied before first step fluid freezes, typically within 3 minutes. (Time may be longer than 3 minutes in some conditions, but potentially shorter in heavy precipitation, in colder temperatures, or for critical surfaces constructed of composite materials. If necessary, the second step shall be applied area by area.)

3 Clean aircraft may be anti-iced with unheated fluid.

CAUTIONS

- For heated fluids, a fluid temperature not less than 60 °C (140 °F) at the nozzle is desirable.
- Upper temperature limit shall not exceed fluid and aircraft manufacturers' recommendations.
- Wing skin temperatures may differ and in some cases may be lower than the OAT. A stronger mix (more glycol) may be needed under these conditions.
- Whenever frost or ice occurs on the lower surface of the wing in the area of the fuel tank, indicating a cold soaked wing, the 50/50 dilutions of Type II or IV shall not be used for the anti-icing step because fluid freezing may occur.
- An insufficient amount of anti-icing fluid may cause a substantial loss of holdover time. This is particularly true when using a Type I fluid mixture for the first step in a two-step procedure.

3.3 Driver-Bucket Teamwork

A. Each time the truck maneuvers around the aircraft the person in the bucket must use the intercom to help the driver. There are a number of factors effecting the driver's visibility during deicing that the bucket person must be aware of.

B. Before moving away from the aircraft, reposition the bucket so that it's safely, within the four sides of the truck.

C. Besides the obvious risks of driving at night in a freezing rain or snow, the driver must battle poor visibility due to smeared windshields and glare.

D. Also, because of the heat of the deicing fluid, a great deal of steam is generated around the aircraft for a short time. Wait until the steam disappears before helping the driver maneuver around the aircraft.

3.4 Deicing/Anti-icing Procedures

A. Once the determination has been made to deice/anti-ice the aircraft, Qualified Deice Personnel will perform the deice/anti-ice procedure.

1. A Qualified Deice Person may be an ABX Air Ground or Maintenance Representative or a Contract Deice Provider who has satisfactorily completed ABX Air Deice Training for the purpose of unsupervised deicing/anti-icing.

2. Deicing Vendors who do not complete ABX Air Deice Training will require oversight during Deicing/Anti-icing of ABX Air aircraft by ABX Air Qualified Deice Personnel. The Pilot In Command is also qualified to oversee the deicing/anti-icing of their aircraft.

B. The first application of deicing fluid will remove any ice, frost, or snow accumulation using heated deicing fluid. ABX Air recommends starting with the tail of the aircarft first, then work up the fuselage to the wings and finishing with the nose of the aircraft.

CAUTION

NEVER SPRAY GLYCOL ON AN AIRCRAFT WHILE A FUEL TRUCK IS FUELING THE AIRCRAFT. WHEN FUEL IS BEING LOADED ON THE AIRCRAFT, THE FUEL TRUCK'S VENTS ARE OPEN. SPRAYING GLYCOL COULD CONTAMINATE THE FUEL LOAD.

1. The deicing application will use the thermal energy of the heated fluid to melt and remove any frozen contamination from the aircraft. (Type I Only) - The fluid temperature must be 140°F or greater before deicing can begin, but not to exceed 200°F.

2. When performing a deicing/anti-icing procedure, accomplish the first step (deicing) by applying the hot fluid with the nozzle as close to the surface as possible without damaging aircraft surfaces. Increasing the distance from the nozzle to the surface results in progressively greater loss of fluid heat and deicing capability. This condition is aggravated as the fluid application pattern is adjusted toward a spray mode. Also, maintain a safe distance between deicing equipment and aircraft surfaces to avoid contact.

3. Always spray from the leading edge to the trailing edge of the aircraft surface. If spraying is not performed in this manner, snow/ ice may be pushed into the balance bays or where it can refreeze and affect the pilot's ability to control the aircraft. The best working distance from the deice / anti-ice nozzle to the aircraft surface is 10-12 feet.

4. Cover the entire aircraft surface by the deicing operation rather than relying on fluid flow-back over contaminated areas. This will provide greater assurance that no frozen precipitation remains under the deicing fluid.

5. As a final precautionary step, apply sufficient fluid to ensure that any remaining diluted fluid on the deiced surfaces (as a result of the deicing process) is displaced by a fluid with a freezing point of at least 10° C (18° F) below the OAT if anti-icing with Type I fluid. In the case of Type II, III, and IV fluids, ensure they are applied in the temperature ranges for undiluted or diluted as shown in the holdover tables. If applied according to the respective holdover tables, the freezing point buffer requirement of at least 7° C (13° F) below the OAT will be met. Determine this by checking the refractive index/BRIX (refer to the manufacturer's information).

6. A Post Deicing Check will be accomplished by the Qualified Deicing Person doing the deicing after the deicing is completed to ensure that the aircraft's critical surfaces are clean.

C. When the aircraft's surfaces have been deiced, an anti-icing application of fluid will be applied before moving to the next surface.

1. This anti-ice application may or may not use the same fluid that was used for the deicing, based on weather conditions or practices. The anti-ice application will be applied as a mist when using Type I or as a gel if using Type II, III, or Type IV fluid. Either type fluid will prevent the reformation of frozen contamination on the aircraft for a period of time per the applicable Holdover Chart. The best working distance from the Deice/Anti-ice nozzle to the aircraft surface is 10-12 feet.

2. Ground testing the effectiveness of Type II and IV fluids is highly dependent on the training and skill of the individual applying the fluids. When these fluids are used, ground personnel should ensure that they are evenly applied so that all critical surfaces, especially the leading edge of the wings, are covered with fluid. In addition, an insufficient amount of anti-icing fluid, especially in the second step of a two-step procedure, may cause reduced HOT because of the uneven application of the second-step fluid.

3. The Holdover Time will start when beginning the anti-ice application. Note: Do not spray hot Type I fluid on the windshield of the aircraft. The hot fluid could crack or craze the windshield.

NOTE

Do not spray hot Type I fluid on the windshield of the aircraft. The hot fluid could crack or craze the windshield.

D. The Holdover Time is the amount of time with prevailing conditions and temperatures that the anti-icing fluid can reasonably be expected to prevent the reformation of frost, snow, or ice on the aircraft's surfaces. The Holdover Time is a very conservative amount of time, and can be interpreted to be the minimum amount of time that the anti-icing fluid will be effective for a given temperature and weather conditions.

E. When the aircraft has been deiced/anti-iced, the flight can take off provided that a satisfactory **Pretakeoff Check** or **Pretakeoff Contamination Check** is performed prior to departure.

1. The **Pretakeoff Check** will be performed after anti-icing is complete and before the expiration of the Holdover Time, but should be as close to the beginning of takeoff as operations will allow.

2. When the **Pretakeoff Check or Pretakeoff Contamination Check** is satisfactorily completed, the **DEICE** block in the M-1A logbook page will be checked by the Flight Crew.

F. Forced Air Systems (FAS) (for additional information Ref. N8900.478)

1. Forced Air Familiarization, the purpose of this training is to familiarize the operator with the deice/anti-ice operations utilizing Forced Air Systems. Forced Air Technology allows the operator to remove accumulated frozen contaminants from the aircraft. Forced Air with heated Type I deicing fluid injected into the airstream may also be used to remove frozen contamination. Using Forced Air Technology with or without type I injected can result in less glycol used reducing the environmental impact.

NOTE

FAS are designed to remove frozen contamination by the use of forced air and/or forced air augmented with Type I fluid injected into or sprayed over a high-speedair stream, or to apply Type II, III, or IV fluids over the airstream as an anti-icing process. In the case of Type I fluids, aircraft surfaces must be anti-iced with heated Type I fluid without using forced air if Type I HOTs are to be used.

2. Forced Air only is permitted and effective in most weather events. The use of Forced Air must be followed up with heated Type I when frozen contaminants are adhering to the aircraft's critical surfaces.

   a. Be advised the use of Forced Air will add another step to the deice process.

   b. Follow forced air with an application of heated Type I, during conditions frozen contaminants are adhering to the aircraft's critical surfaces.

   c. When anti-icing is required, forced air must be followed up with one or two step deice/anti-ice process to establish a holdover time.

   d. Using Forced Air the operator will approach the aircraft using the same process and approach when spraying ADF, as described in Chapter 3 Figure 3-3.

   e. When using Forced Air Technology keep the nozzle at least 5 feet away from the aircraft at a 45° angle.

CAUTION

DO NOT DIRECT FORCED AIR AT THE AIRCRAFT'S WINDSHIELD, APU INLETS/ EXHAUST, ENGINES, PITOT TUBES, STATIC PORTS, ANGLE OF ATTACH SENSORS OR ANY OTHER INSTRUMENTATION. USE CAUTION AROUND THE WHEEL AND GEAR AREA PREVENTING LOOSE DEBRIS FROM STRIKING THE AIRCRAFT. BE CAUTIOUS IF PERSONNEL ARE IN THE AREA WHEN USING FORCED AIR.

NOTE

Forced Air only can be used during cold dry snow conditions where the frozen contaminates are not adhering to the aircraft's surfaces. This must be communicated to the Flight Crew Forced Air only with no holdover time.

3. Forced Air Technology with Type I

   a. Forced Air with Type I fluid must be followed up with a one or two step deice/anti-ice process to establish a holdover time. The deice/anti-ice application must be accomplished within 3 minutes of the forced air with type I application.

   b. Using Forced Air the operator will approach the aircraft using the same process and approach when spraying ADF, as described in Chapter 3, Figure 3-3.

   c. When using Forced Air Technology keep the nozzle at least 5 feet away from the aircraft at a 45° angle.

> CAUTION
>
> **DO NOT DIRECT FORCED AIR AT THE AIRCRAFT'S WINDSHIELD, APU INLETS/ EXHAUST, ENGINES, PITOT TUBES, STATIC PORTS, ANGLE OF ATTACH SENSORS OR ANY OTHER INSTRUMENTATION. USE CAUTION AROUND THE WHEEL AND GEAR AREA PREVENTING LOOSE DEBRIS FROM STRIKING THE AIRCRAFT. BE CAUTIOUS IF PERSONNEL ARE IN THE AREA WHEN USING FORCED AIR.**

> NOTE
>
> **Forced Air with Type I as the final application must be communicated to the Flight Crew Forced Air only with no holdover time.**

4. Additional Precautions for FAS:

   a. Ear protection is required when noise levels exceed 85 decibels (dB).

   b. Exercise caution around ground personnel. The potential for blowing ice chunks that may strike ground personnel and restricted visibility due to blowing loose snow are possible problems.

   c. Exercise caution to avoid the following:

      1. Directing forced air into sensitive aircraft areas (e.g., pitot tubes, static ports, and vents).

      2. Blowing snow or slush into landing gear and wheel wells.

      3. Blowing ice, snow, and slush into aircraft engine inlets, auxiliary power unit (APU) inlets, and control surface hinges.

      4. Allowing loose debris to impact other aircraft surfaces.

> NOTE
>
> **Information regarding a specific system can be obtained from the manufacturer's technical literature. SAE document AIR6284, Forced Air or Forced Air/Fluid Equipment for Removal of Frozen Contaminants, provides some information of FAS usage, limitations, and precautions. This document is available Link to SAE Document (Note: Must be Purchased)**

G. The **Pretakeoff Check** is normally performed by the Flight Crew or when necessary, tactile or remote operations by Qualified Deicing Personnel. The Flight Crew will inspect the **representative surfaces** of the aircraft to ensure that the anti-ice fluid is still effective.

1. The **representative surfaces** on the B-767 may be viewed from the #2 cockpit window(s) after the parking brake has been set and will consist of a check of sufficient portions of the wing leading edges and upper surfaces.

> CAUTION
>
> **DO NOT UTILIZE THE MAIN ENTRY DOOR ON THE B-767.**

2. Use wing leading edge flood lights and nacelle lights at night to illuminate the **representative surfaces**.

3. Anti-iced surfaces should retain their glossy appearance with no accumulation of snow or ice apparent.

4. If the flight has not departed within the specified Holdover Time, a **Pretakeoff Contamination Check** must be performed before takeoff.

   a. If Holdover Time has expired, the Flight Crew must perform a **Pretakeoff Contamination Check** to ensure that the representative surfaces are free of any frozen contamination.

> NOTE
>
> **If Holdover Time has expired, the aircraft DOES NOT necessarily need to be deiced. The Pretakeoff Contamination Check will determine the need for additional deicing.**

> CAUTION
>
> **HOLDOVER TIME FOR ICE PELLETS CANNOT BE EXTENDED BY A PRETAKEOFF CONTAMINATION CHECK.**

   b. If the **Pretakeoff Contamination Check** is satisfactory, the aircraft must depart within 5 minutes without additional checks.

   c. If the aircraft does not takeoff within 5 minutes, another **Pretakeoff Contamination Check** must be accomplished.

   d. There is no limit to the number of **Pretakeoff Contamination Checks** that may be performed, as long as the **representative surfaces** remain clear of any frozen contamination.

5. If a **Pretakeoff Contamination Check** is unsatisfactory, the aircraft must be deiced/anti-iced again before the aircraft may takeoff. After subsequent deicing/anti-icing, a new holdover time must be established and a **Pretakeoff Check** must be accomplished before takeoff.

6. Anti-Icing in a Hangar

   a. There are operational conditions when air operators may choose to anti-ice their aircraft while the aircraft is in a heated hangar. This is one way to reduce the consumption of deicing fluid and to minimize the environmental impact of deicing.

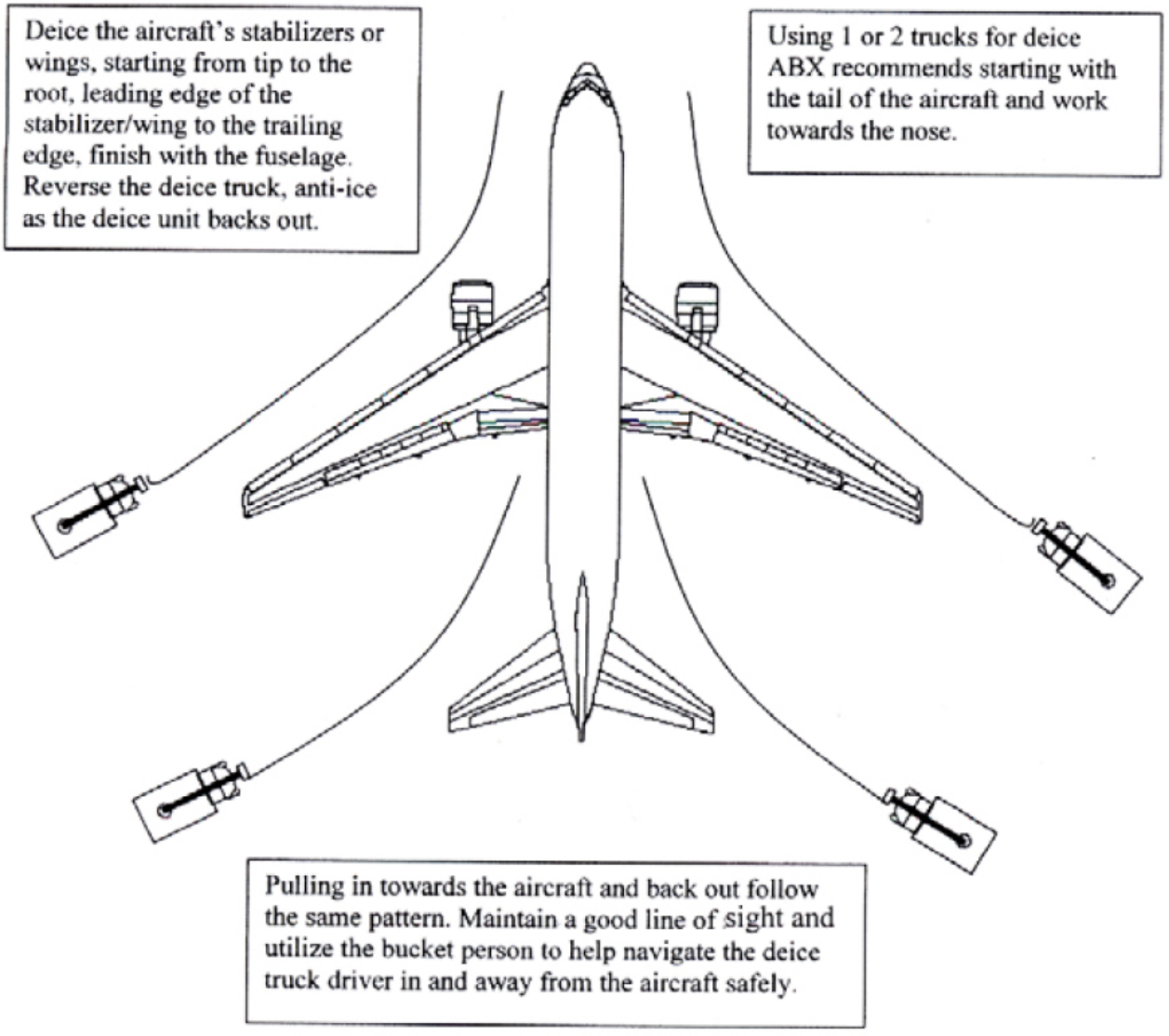
b. The period of time after fluid application and the air temperature in the hangar both have an effect on the ability of the fluid to protect the aircraft when it is pulled out of the hangar and into freezing/frozen precipitation. The HOT for a fluid is based largely on the fluid's thickness on the surface. The fluid thickness varies with time and temperature.

   1. HOT clock must be started at the time of the first application of anti-icing fluid onto a clean wing. It may not be started when the aircraft is first exposed to freezing/frozen precipitation.

7. The following diagrams demonstrates deice truck(s) movement around the aircraft.

   a. ABX recommends deice should start with the tail of the aircraft and work towards the nose. This will prevent the possibility of tail tip during deice. Also the last fluid applied will be on the wings.

Figure 3-3, Truck Movements Around Airplane



3.5 Aircraft Deicing Procedures - Boeing 767

A. These positions around the B-767 **are recommended** under "normal" conditions where wet snow and ice are present or are anticipated with winds of 5 miles per hour or less. If at all possible, position the deice trucks between the wind and the aircraft.

B. The deicing of the aircraft should begin with the tail and (if conditions other than frost exist), the fuselage and, finally, the wings. If fuselage deicing is required, position the bucket over the fuselage of the aircraft using the boom controls. If wet snow and ice are anticipated or present, aim the fluid at the top of the fuselage and work back toward you in a sweeping motion so both sides of the cockpit and fuselage are covered. Adjust the nozzle setting to reach the cockpit. Keep the angle of the spray at a 45 degree angle or less.

C. Items not to be directly sprayed are:

1. Cockpit Windshields
2. Pitot Tube
3. Air Temperature Probes
4. Static Ports
5. Angle of Attack Vanes
6. Engine Inlets
7. Engine Exhaust
8. Door Openings
9. APU Inlet

Figure 3-4, 767 Tail

D. Use the boom controls to position the bucket to spray the tail of the aircraft.

E. The critical surfaces of this spray on the tail are as follows:

1. Vertical Stabilizer

2. Rudder
3. Leading Edge of the Horizontal Stabilizer
4. Horizontal Stabilizer Upper Surface
5. Stabilizer Lower Surfaces (if required)
6. Elevator

NOTE

Do not spray fluid directly into APU inlet located on the fuselage to the right of the vertical stabilizer. When APU door is open, notify Flight Crew that deice is ready to begin so the Flight Crew can shut off the air conditioning system.

Figure 3-5, 767 Wing

F. After clearing the tail, reposition the boom and the truck to deice the wings. The best distance for deicing is 10-12 feet from the nozzle to the surface being deiced.

G. The critical surfaces for deicing the wings include:

1. Ailerons Inboard/Outboard
2. Flight Spoilers
3. Ground Spoilers
4. Flaps Inboard/Outboard
5. Wing Upper Surface
6. Leading Edge Slats
7. Wingtip Devices Identified as Critical Surfaces Wingtip devices have various names, including winglets, strakes, sharklets, or raked wingtips. The guidance below applies for these devices.

    a. Without Split Scimitars or Strakes (Winglets, Sharlets, etc.). These devices must be confirmed to be free of frozen contamination as part of the pretakeoff check. Current practices include a visual scan or the use of an approved representative surface.

b. With Split Scimitars, Strakes, or Similar Devices. A new wingtip device element, the strake, has been introduced and is part of the split scimitar. The strake is installed outboard of the vertical component of the wingtip device and extends downward and therefor cannot be observed from inside the aircraft. Manufacturers may designate the upper inboard surface of the vertical element of the wingtip device as a representative surface to assure no frozen contamination is present. The anti-icing procedures specified require this inboard surface to be anti-iced first starting at the top and working downward. The strake is anti-iced after the inboard surface application is completed. A visual scan of the designated representative surface (upper inboard surface of the vertical element of both wingtips) is required prior to takeoff as part of the pretakeoff check. This paragraph applies only to aircraft with split scimitar wingtip devices.

c. Boeing Wingtip Devices currently in use on the B737 (including Wingtip Devices with Split Scimitar Elements), B747, B757, B767, and MD11. Boeing has demonstrated that these wingtip devices do not require a visual inspection as part of the pretakeoff check if a complete deicing of these wingtip device surfaces is accomplished during the aircraft deicing procedure. Following the accomplishment of the wingtip device deicing procedure, no further action concerning the wingtip device is required as long as the determined HOT does not expire before departure. Upon expiration of the determined HOT prior to departure, a pretakeoff contamination check must be accomplished. This check must include a visual inspection of the wingtip devices, and if adhering frozen contamination is detected, the aircraft must return for appropriate ground deicing/anti-icing retreatment prior to departure.

8. When spraying these and any areas of any aircraft, make sure that the fluid stream strikes that aircraft surface at a 45 degree angle or less so that the aircraft surface isn't distorted. Adjust the spray pattern or control handle as the spray gets closer to you.

9. Upper Surfaces, including any vortex generators.

10. Avoid hitting the vortex generators directly because you may damage them.

H. If light frost conditions exist, “mist” the wings with a spray pattern. In light frost conditions, only the wings, tail and control surfaces need to be deiced/anti-iced. If the aircraft wing is clean the surface of the aircraft appears wet and glossy-smooth. The lower surface of the wing may need deiced if more than an 1/8 inch of frost.

I. At the nose of the aircraft check the condition of the cockpit windshield. Aim a misting stream at the fuselage above the windows so the deice fluid cleans them by dripping down over them. **Never spray hot fluid directly on windshields.**

Figure 3-6, Nose of the Airplane

J. In addition, all snow must be removed from the nose radome area to prevent snow from blowing back and obscuring the pilot's vision on takeoff.

Figure 3-7, 767 Engine

K. If it's necessary to deice the underside of the aircraft, do not spray fluid directly into the:

1. Engine Inlets
2. Engine Exhaust

L. In addition to the underside of the wing, the main gear of the aircraft may need to be deiced. Flight Crews will check the landing gear wheel well areas and tires and will contact aircraft maintenance for support if these areas need to be deiced.

Figure 3-8, 767 Main Gear

M. The items around the main gear include:

1. Inboard Gear Doors
2. Outboard Gear Doors
3. Door Latches
4. Uplock Hook
5. Downlock Mechanism
6. Bungee Springs
7. Lock Actuators
8. Position Indication Switches.

Once notified, aircraft maintenance will examine the wheel well area and advise the best means to deice this area as not to damage or remove the lubrication on these moving parts.

N. After completion of deicing and after performing the Post Deicing Check of the fuselage and wings, the qualified Deicing Personnel will notify the Flight Crew by means of a Crew Deicing Report that deicing is complete and that anti-icing, if required, has begun.

Figure 3-9. Boeing 767

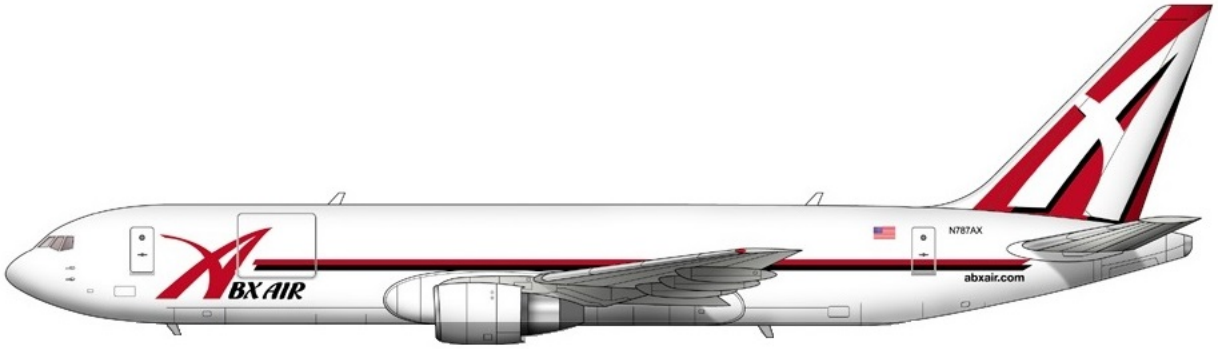
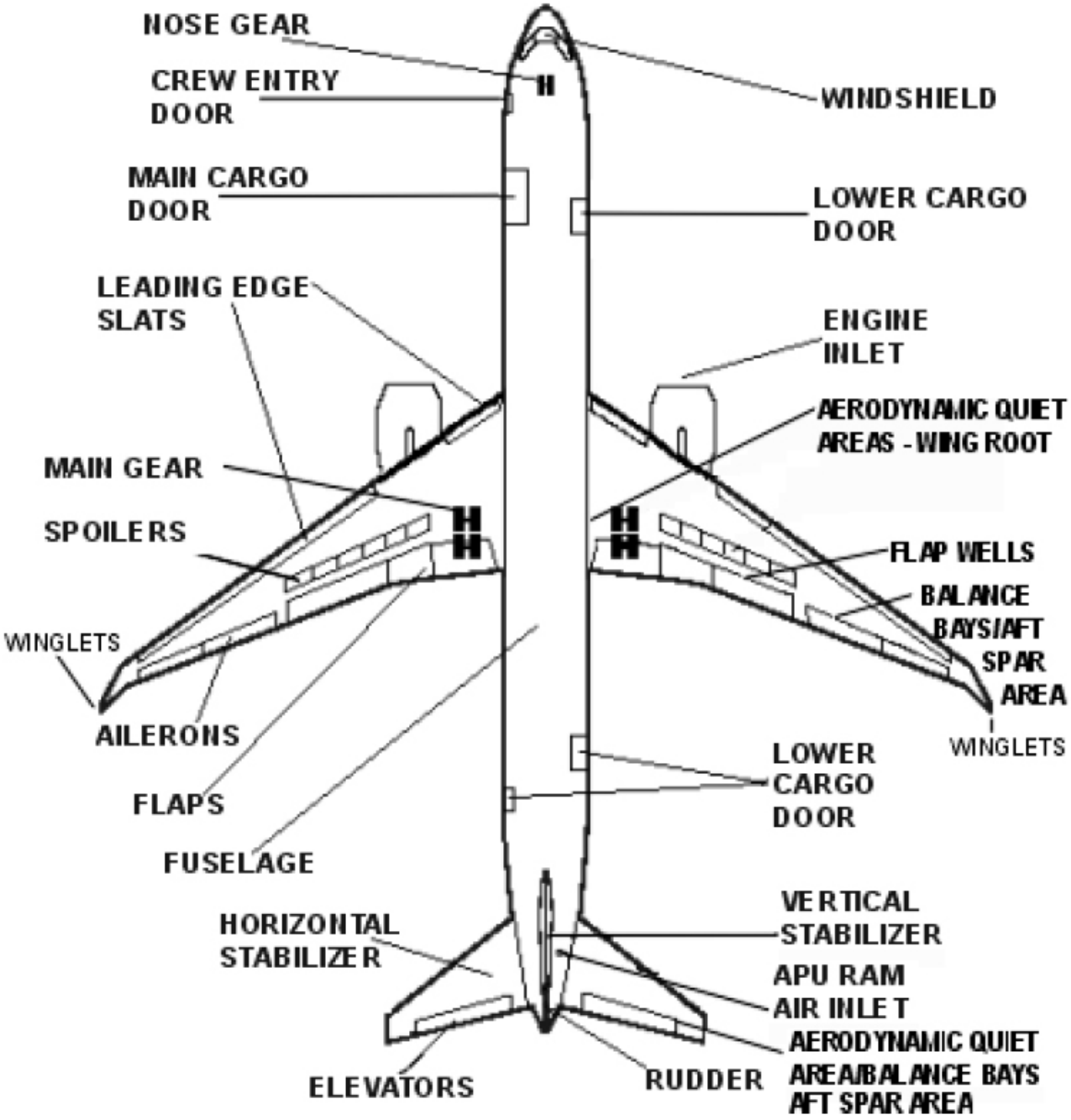


Figure 3-10, Boeing 767 with Descriptors



3.6 Effects of Icing On Aircraft

Aerodynamic Effects of Icing

A. Types of In-flight Icing

1. Clear Ice

a. Clear ice forms when water drops impact the aircraft surface and spread out, freezing and forming a thin, smooth sheet of ice.

b. Usually forms due to large rain drops or in cumuliform clouds.

c. Clear ice is heavy and hard in nature.

d. This form of ice is very difficult to detect because of its transparent nature, and is especially difficult to remove with deicing equipment.

2. Rime Ice

a. Rime ice forms when small water droplets impact the aircraft surface and freeze rapidly, trapping air in the ice and giving rime ice a whitish appearance.

b. Usually forms in light drizzle or stratiform clouds.

c. Rime ice is light in weight and brittle in nature.

d. This form of ice is easier to detect because of its whitish appearance and can be removed more easily with deicing equipment.

e. Rime ice is irregular in shape, disrupting the smooth airflow over the aircraft surface and reducing lift and flight control effectiveness.

3. Mixed Icing

a. This type of icing forms when water drops vary in size, and can be mixed with ice particles or snow.

b. Mixed icing can form very rapidly.

c. Ice particles may be mixed with clear ice, forming a very rough, mushroom-shaped accumulation on the leading edges.

B. Icing Intensities

1. Icing intensities are determined by the rate of accumulation and effectiveness of airfoil deicing/anti-icing:

2. Trace

a. Ice becomes perceptible with rate of accumulation slightly higher than rate of sublimation.

b. Usually is not hazardous even without utilizing deicing/antiicing equipment, unless encountered for extended period of time (more than one hour).

3. Light

a. Rate of accumulation may create a problem if encountered for prolonged period of time (more than one hour).

b. Occasional use of airfoil deice/anti-ice equipment removes or prevents accumulation.

4. Moderate

a. Rate of accumulation may be hazardous even for short encounters.

b. Airfoil deice/anti-ice equipment usage required or even diversion of flight.

5. Severe

    a. Rate of accumulation cannot be reduced or controlled by airfoil deice/anti-ice equipment.

    b. Immediate flight diversion may be necessary.

C. Transport aircraft are designed to fly safely within an icing environment provided the aircraft is operated as recommended.

1. Aerodynamically that usually means little or no ice, frost or snow accumulation, particularly on the wing or tail surface, unless those surfaces are specifically designed to perform their function with inflight ice accumulation.

2. Surfaces required to be free of in-flight ice accumulations are protected by onboard deicing or anti-icing systems.

3. Aircraft are not normally designed to operate with, or protect itself against ice, frost or snow accumulations that can occur while on the ground.

4. Such protection must be provided by ground anti-icing prior to takeoff.

D. Regardless of the choice made by the aircraft manufacturer to either ice protect a surface or design it to perform its function without such protection, the certification process requires demonstration of the resultant flight characteristics.

1. Artificial simulations of in-flight ice accretions are fabricated and fastened to all significant surfaces that are not ice protected.

2. The aircraft is then flown to demonstrate compliance with applicable requirements.

E. Boeing B-767

1. The Boeing 767’s Tail surfaces do not have any deicing capabilities at all.

2. The Boeing 767’s wings only have deicing/anti-icing capabilities on the outboard leading edges.

F. Ice occurring on a lifting surface, other than on a surface specifically designed to operate with an ice accumulation, can cause a loss of maximum lift and a reduction in the angle of attack at which the stall occurs.

G. Ice accumulations can also cause a degradation of handling qualities at and beyond the stall such as abrupt roll off and pitch up.

A. Premature stalling due to ice accumulations can occur with little or no warning on aircraft having stall warning systems dependent on input from angle of attack vanes or wing leading edge lift transducers.

B. As far as the angle of attack sensor knows, the wing is still at a flyable angle of attack, while the wing may actually have stalled long before.

H. Deceptively small amounts of airfoil surface roughness can have a large effect.

1. A moderate coating of frost can easily add 5 to 10 knots to normal stall speeds, and is believed to have been a contributing factor in several takeoff accidents involving aircraft without leading edge high lift devices.

2. For very small accretions of ice, frost or snow, wing leading edge slat extension will recover most of the increase in stall speed.

3. However, as the amount of accretion increases the beneficial effects of slat extension are reduced At moderate amounts of accretion slats provide little or no protection against premature stall.

I. Ice, frost, or snow accumulations of as little as 1/8" on control surfaces may cause in flight flutter.

J. During takeoff, ice, frost, or snow accumulations will reduce the amount of lift available at a given angle of attack.

1. This requires higher pitch attitudes to achieve lift-off and will reduce the angle of attack at which stall occurs (possibly below the angle of attack which stall warning is activated) leaving little or no margin for maneuvering or gust tolerance until the aircraft accelerates above normal takeoff speed schedules.

2. Under these conditions, any mild windshear, gust or additional pull-up immediately following lift-off can stall the aircraft.

K. Effect of Icing on Engine Operation

1. Turbofan engine inlet icing can cause disturbed airflow and consequent compressor stalling or engine flameout.

a. Inlet icing can occur in any conditions that cause airfoil icing.

b. Inlet icing may occur in ambient temperatures above freezing, such as during operations at low forward speed such as ground operations where there is a substantial pressure drop in the engine inlet causing a temperature drop of as much as 6° C.

c. This pressure drop does not exist in flight as high ram pressures maintain engine inlet pressure.

2. In conditions under which the flight manual requires the use of engine anti-ice for takeoff, the engine anti-ice should be turned on immediately after the engine has been started and stabilized as inlet ice may accumulate rapidly. If activation of engine anti-ice is delayed, engine damage may result as any ice accumulated will then break loose and be ingested by the engine.

3. On Pratt & Whitney engines, a blocked PT_2 probe will cause EPR indication errors.

a. Inside the engine inlet bullet the PT_2 measuring system has a drain section containing a small bleed orifice.

b. The normal PT_2 loss through this orifice is accounted for by the EPR indicating system.

c. If the PT_2 probe becomes blocked the EPR indicating system will read bullet internal pressure.With engine anti-ice off, the venturi action caused by engine inlet air rushing over the bullet vents lowers the bullet internal pressure, and a lower than actual PT_2 is used for computing EPR. This condition would result in a higher than actual EPR indication. With engine anti-ice on and a blocked PT_2 probe, internal bullet pressure will be higher than actual PT_2. and reading a higher than actual PT_2 would result in a lower than actual EPR indication.

4. Ice crystals such as encountered during high altitude flight in cirrus clouds, although not posing any airframe or engine inlet icing problems, may cause PT_2 probe blockage.

    a. During high altitude flight through visible moisture, turn on the engine anti-ice if an unaccounted for rise in EPR is observed.

L. Preflight Inspection (Preflight External Aircraft Icing Check)

1. During winter operations when snow, ice and/or freezing precipitation is present, allow extra time to complete a more extensive walk-around inspection at originating points and intermediate stops. Call any need for deicing to the attention of deicing personnel as soon as possible as to avoid delay.

2. During a cold weather walk around inspection, check the general areas of the aircraft. Flight crews should reference the B767 AOM for Cold Weather Operation Specifics.

    a. Inspect airplane for accumulations of snow, frost, ice on wings, tail and fuselage, and control surfaces.

    b. Operate the flight control surfaces, tabs and flaps, where practicable.

    c. Check landing gear struts, actuating cylinders, locking mechanism, wheels and brakes, gear cover doors, etc. for freedom from ice, snow, slush and mud.

    d. Check landing gear micro-switches for freedom from ice.

    e. Check nose wheel rims for ice accumulation which could cause imbalance and nosewheel shimmy on takeoff.

    f. Check tires and struts for proper inflation and insure that the tires are not frozen to the ground or to the chocks.

    g. If ice or snow accumulations are found in the wheel well and/ or landing gear areas, flight crews should contact maintenance for deicing support.

    NOTE

    After landing in icing conditions, leave the flaps extended for inspection of the flap hinges, actuators, and tracks as applicable.

3. Frost must be removed from all critical surfaces, <u>except</u> for the fuselage and up to 1/8” frost on the lower wing surfaces.

4. A thin layer (up to 1/8”) of underwing frost generally does not influence aircraft performance and will not require removal.

5. In very cold conditions (generally below -10 to -15° C (14 to 5° F) or colder) dry snow can fall onto cold aircraft wings. Under these conditions, dry snow will swirl as it blows across the wings, making it evident the snow is not adhering. But, if snow has accumulated on the surface of the wings, it has to be removed before takeoff. It cannot be assumed that accumulations of snow will blow off during takeoff.

6. Except as noted, all ice, frost, or snow accumulations must be removed from all lifting and control surfaces.

7. Check for ice, snowy or slush accumulations on:
   a. Slat and flap tracks, fairings and channels.
   b. Blocked pitot tubes and static ports.
   c. Landing gear doors and struts, wheel wells, and Ground/Flight mechanisms.
   d. Wheel rims (ice or slush accumulations may cause out-ofbalance condition).
   e. Engine inlets and exhausts.

   NOTE

   Any snow accumulations should be removed from the aircraft nose as the snow may blow onto the windshield during takeoff, causing loss of visibility.

8. Inspect all control surfaces for ice and snow accumulations that could interfere with control surface movement and actuate all control surfaces and trim tabs to full throw.
9. After refueling, recheck the upper wing surfaces as loading warm fuel into a wing with snow accumulations could melt the snow which would then refreeze as a clear sheet of ice.
10. If the fuel temperature is below freezing when it is pumped into a relatively warm, wet wing, it can cause the moisture to freeze and may easily be mistaken for liquid droplets.

M. Aircraft Critical Surfaces - In general, the following items must be free from snow, ice, frost, or frozen contamination and will require a close inspection:

1. Wing leading edges and upper surfaces

   NOTE

   ABX Air aircraft may be released for flight with up to 1/8” of frost on the wing lower surfaces caused by super cooled fuel in the wings.

2. Ailerons, including trim and control tabs
3. Horizontal and vertical stabilizers
4. Elevators, including trim and control tabs
5. Rudder, including trim and control tabs
6. Pitot tubes and static ports
7. Engine inlets
8. Flaps and their associated hinges and tracks
9. Main and nose gear up/down lock mechanisms

N. 767 Specific Areas In addition to the critical surfaces, inspect the following aircraft specific items to ensure that they are free from any adhering frozen contamination:

1. Wing leading edge slats
2. Spoiler panels
3. Angle of attach vanes
4. Fuel tank vent
5. Wheel well and landing gear areas

Chapter 4 - DEICING/ANTI-ICE FLUID ACCEPTANCE

4.1 Fluid Quality Control (QC)

A. QC checks of all stored fluids should be performed before the start of the deicing season. At a minimum, the checks for all fluid types should include visual inspections of the fluid and the containers for contamination and separation, refractive index measurements, and pH measurements. All values should be within the limits recommended for the manufacturer's specific fluid type and brand.

1. Temperature Conversion Chart - degrees F to degrees C.
2. Mixture Percent Glycol vs. Minimum Allowable OAT for Application Chart
3. Type I Fluid Freezing Point Chart
4. MSDS (Material Safety Data Sheet) available from Product Manufacturer

4.2 Freezing Point Depressant (FPD) Deicing Fluids

A. Fluid Description

1. Type I Fluids

a. Glycol-based fluids used for aircraft deicing and anti-icing. These low viscosity fluids generally contain a minimum of 80% glycol in their undiluted state before the mixing with water occurs. These fluids are referred to as FPD (freezing point depressant) fluids because of properties which cause its freezing point, when diluted with water, to be lower than either water or the undiluted fluid. Due to low viscosity, the hold over times for Type I fluids are limited.

b. Mixtures of ethylene/propylene Type I fluids greater than approximately 60% glycol to 40% water mix should not be used as their freezing point becomes undefined. Type 1 fluid are transparent and dyed translucent orange in color.

NOTE

Do not spray hot Type I fluid on the windshield of the aircraft. The hot fluid could crack or craze the windshield.

2. Type II Fluids

a. Glycol-based fluids which have been thickened to increase hold over times when used as an aircraft anti-icing fluid. The increased viscosity is reduced by "shear" movement of the fluid. The “shear” can be caused by airflow over the surface (wing) and can also be the results of mishandling of the fluid.

b. Type II fluids must not be used on aircraft with rotation speeds of 100 knots or less due to insufficient shearing forces and the associated lift degradation from the high viscosity fluid on the lifting surfaces. Type 1I fluids are a pale straw color/ to clear.

3. Type III

   a. Type III fluids are slightly thickened and can be used for aircraft heated deice or unheated anti-ice purposes. Type III is a de/antiicing fluid designed for aircraft with lower rotation speeds and shorter takeoff rolls. Type III fluids are dyed fluorescent yellow in color.

   NOTE

   Do not spray hot Type III fluid on the windshield of the aircraft. The hot fluid could crack or craze the windshield.

4. Type IV

   a. Glycol-based fluids which have been thickened to increase hold over times when used as an aircraft anti-icing fluid. The increased viscosity is reduced by "shear" movement of the fluid. The “shear” can be caused by airflow over the surface (wing) and can also be the results of mishandling of the fluid.

   b. Type IV fluids must not be used on aircraft with rotation speeds of 100 knots or less due to insufficient shearing forces and the associated lift degradation from the high viscosity fluid on the lifting surfaces Type IV fluids are dyed translucent green.

   NOTE

   Do not spray Type II, Type III or IV anti-ice fluids on the windshield. The thickened fluid greatly reduces visibility.

   NOTE

   No Holdover Times exist for Type II, III, IV anti-ice fluids when applied heated.

B. Deicing/Anti-icing Fluid Acceptance Procedures [Ref. GRH 4.2.4]

1. Provide escort for transport driver per vendor escort policy.

2. Airport facility operator shall receive a certification document from Deicing supplier or shipping agent certifying product to be delivered to airport meets SAE specifications and requirements.

3. Verify that the product being delivered is correct type and quantity.

4. Facility operator shall prepare receiving tank(s) and facility items prior to delivery of product, i.e., gauging, correct inlet and outlet valve positioning, etc.

5. At time of delivery and prior to connecting truck discharge hoses, transport truck driver and facility operator are to review and agree that product delivery documentation and procedures are in place to ensure satisfactory product receipt.

6. Truck unloading hoses and fittings are to be inspected for deficiencies, pending failures and cleanliness prior to connection to deice facility receiving connections.

7. Verify that both the bottom and the top hatch are sealed with numbered, anti-tamper seals.

8. Obtain sample of product being delivered.

9. Conduct the following tests:

    a. Type I

        1. Perform visual appearance test.

        2. Dilute product to a 50/50 mix with tap water using and acceptable means of measurement.

        3. Test product using a handheld, calibrated, refractometer or Palm Abbe.

        4. Verify test results with the "Certificate of Analysis" that accompanied the load being delivered.

        5. If accepted, retain a fluid sample, complete Deicing/ Anti-icing Acceptance form, and begin unloading product.

        6. If rejected, complete the "rejected" section of the form, retain a fluid sample, a copy of shipping document, and notify your supervisor.

    b. Type IV

        1. Perform visual appearance test.

        2. Test product using a handheld, calibrated, refractometer or Palm Abbe.

        3. Verify test results with the "Certificate of Analysis" that accompanied the load being delivered.

        4. If accepted, retain a fluid sample, complete Deicing/ Anti-icing Acceptance form, and begin unloading product.

        5. If rejected, complete the "rejected" section of the form, retain a fluid sample, a copy of shipping document, and notify your supervisor.

10. Upon completion of receipt by transport truck, facility operator shall; close inlet valve(s) on receipt tank(s).

11. Provide escort for transport.

12. Storing ADF

    a. Type I can be stored under proper conditions for minimum of three (3) years and can be extended.

    b. Type IV can be stored under proper condition for minimum of two (2) years and can be extended.

    c. Totes need to be stored inside or covered with tarps to protect the ADF from UV rays that sit outside.

Figure 4-1, Deice/Anti-Ice Fluid Acceptance Form

EXAMPLE

Deicing/Anti-icing Fluid Acceptance Form

Date _____ Station _____

Employee Number _____ Signature _____

Deicing/Anti-icing Fluid Delivery Information

Trucking Company Name _____
Drivers Name _____
Trailer ID Number _____
Fluid Lot Number _____
Time of Delivery _____
Quantity Delivered _____
Location/Tank number _____

Tanker Seals
Numbers _____
Top Hatch intact yes no
Bottom Hatch intact yes no

This fluid shipment was ☐ Accepted ☐ Rejected

Type I Fluid Acceptance

Product Supplier _____

Product Name _____

Fluid Appearance ☐ Clean ☐ Particles in fluid

Fluid Color Manufactured Specified Color ☐ yes ☐ no

Freeze Point ☐ Refractive Index ☐ Brix

Type IV Fluid Acceptance

Product Supplier _____

Product Name _____

Fluid Appearance ☐ Clean ☐ Particles in fluid

Fluid Color Manufactured Specified Color ☐ yes ☐ no

Freeze Point ☐ Refractive Index ☐ Brix

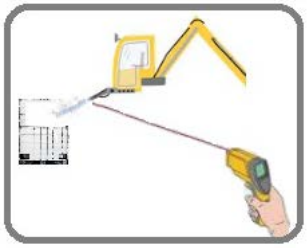
C. Fluid Testing requirements.

1. By October 15 of each year, Type I fluid freeze point test will be completed and documented on the deice truck or facility placard.

CAUTION
Type I must be heated to a minimum of 140°F/60°C before deicing an aircraft.

2. The deice provider should specify a process that meets their needs and mitigates the risk of temperature drift or error depending upon the temperature control system installed in their deicing equipment, to periodically verify the minimum Type I fluid temperature is achieved and meets the temperature parameters specified in the FAA HOT Guidelines an ADF temperature at the nozzle of 140ºF/60ºC or greater. The deice vendor is responsible for specifying the process they will use to ensure Type I fluid temperature readings are accurate, and that process must be acceptable to the Administrator.

Figure 4-2 Type I Temperature Testing



3. The deice provider will document and maintain records of the periodic nozzle temperature check for auditing purposes throughout the deice season. Document can be hard copy similar to Figure 4-3 , or a digital record.

Figure 4-3 ABX Air Type I Fluid Temperature Form

ABX AIR

Example

Date:		Qualified Deice operator:		
Station:				
Deice Truck#	Thermometer #	purchase/Calibration dateof hand held thermometer if applicable	Type I Temperature reading (handheld)	Temperature reading on the deicer
DU-002				
DU-003				
DU-004				
DU-005				
DU-006				
DU-007				
DU-008				
DU-009				
DU-010				
DU-011				
DU-012				
DU-6073				
DU-6074				
DU-6075				
DU-6076				
DU-402				
DU-403				
DU-404				
DU-405				
DU-482				
DU-483				
DU-504				

Maintain completed records on file for 1 year

Revision 2, August 2024

4. If the temperature test is below 140°F/60°C, remove the deice until from service unit it is corrected.

5. Type IV samples will be pulled from all storage tanks and the glycol facilities and each of the deice trucks that stored Type IV fluid during the summer.

Figure 4-4. Testing Deice Fluid

6. Using a large trash can with new clean trash can liner to collect a sample or spray the Type II or IV on to a clean aluminum surface.

7. Each deice truck requires a nozzle test for Type IV.

8. Fluid samples will be collected and tested according to recommendations as set forth by the manufacturer.

Figure 4-5. Deice Fluid Sample

9. During the deicing season, if a truck requires a nozzle or pump replacement on the Type IV system, a new sample from the deice trucks nozzle is required to be sent to the fluid manufacturer for verification to ensure the fluid will perform according to specifications.

D. Deicing/anti-icing will be accomplished with a Freezing Point Depressant fluid, either Type I, Type II, Type III fluid or Type IV fluid.

E. Freezing point depressant fluids are a mixture of glycol and water that, when mixed, will have a lower freezing point than either glycol or water alone.

F. Type I fluid may be either an ethylene glycol/water or propylene glycol/ water mixture.

G. Type I fluids are thinner than Type II, Type III and Type IV fluids and, due to it's lower viscosity, will have a shorter holdover time.

H. Type I fluids may be applied at ambient temperatures as low as -41° C, but the freezing point of the fluid must be at least 10° C below the outside air temperature.

I. The minimum allowable OAT for Type I fluid application may be determined by the Mixture Percent Glycol vs. Minimum Allowable OAT for Application chart. (see the Chart in Chapter 3).

4.3 Mixture Percent Glycol vs. Minimum Allowable OAT for Application

A. The qualified deice personnel are responsible for checking and ensuring the mixture of the Type I fluid being applied is adequate for the OAT.

B. Type I fluid will freeze at various temperatures, based on the amount of glycol mixed with water.

1. The minimum amount of glycol to water for anti-icing purposes will be a 25/75 mixture.

2. The maximum amount of glycol to water for anti-icing purposes will be a 60/40 mixture.

NOTE

At ratios above 60/40 mixture, the freezing point of Type I fluid becomes undefined.

C. As the amount of glycol to water ratio is increased, the freezing point of the mixture and the minimum allowable OAT for its use decreases to a point.

1. The freezing point of Type I fluid must be at least 10° C below the ambient temperature.

D. After determining the type and mixture of Type I fluid, reference this chart to ensure that the ambient temperature is not below the minimum allowable OAT for the mixture in use.

NOTE

As ethylene glycol and propylene glycol have different freezing points, ensure the correct temperature from the chart is used for the type of fluid in use.

1. For example, a 50/50 mixture of ethylene glycol/water has a minimum allowable OAT for use of -28° C, while the same mixture of propylene/ water has a minimum allowable OAT for use of -22° C.

Figure 4-4 Freezing Point versus Dilution Chart

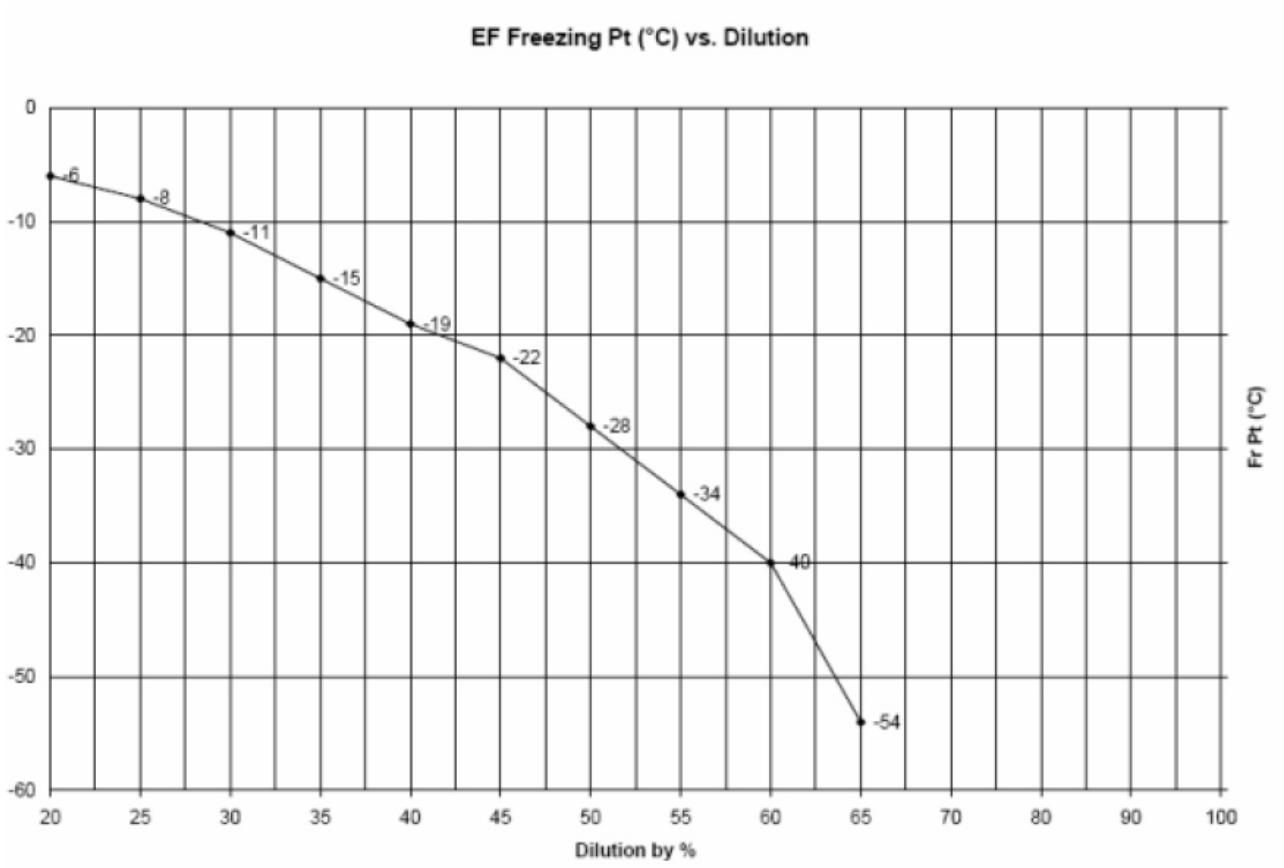


Figure 4-5 Temperature Conversion Chart

TEMPERATURE CONVERSION									
°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-45.6	-50	-27.2	-17	-8.9	+16	+9.4	+49	+27.8	+82
-45.0	-49	-26.7	-16	-8.3	+17	+10.0	+50	+28.3	+83
-44.4	-48	-26.1	-15	-7.8	+18	+10.6	+51	+28.9	+84
-43.9	-47	-25.6	-14	-7.2	+19	+11.1	+52	+29.4	+85
-43.3	-46	-25.0	-13	-6.7	+20	+11.7	+53	+30.0	+86
-42.8	-45	-24.4	-12	-6.1	+21	+12.2	+54	+30.6	+87
-42.2	-44	-23.9	-11	-5.6	+22	+12.8	+55	+31.1	+88
-41.7	-43	-23.3	-10	-5.0	+23	+13.3	+56	+31.7	+89
-41.1	-42	-22.8	-9	-4.4	+24	+13.9	+57	+32.2	+90
-40.6	-41	-22.2	-8	-3.9	+25	+14.4	+58	+32.8	+91
-40.0	-40	-21.7	-7	-3.3	+26	+15.0	+59	+33.3	+92
-39.4	-39	-21.1	-6	-2.8	+27	+15.6	+60	+33.9	+93
-38.9	-38	-20.6	-5	-2.2	+28	+16.1	+61	+34.4	+94
-38.3	-37	-20.0	-4	-1.7	+29	+16.7	+62	+35.0	+95
-37.8	-36	-19.4	-3	-1.1	+30	+17.2	+63	+35.6	+96
-37.2	-35	-18.9	-2	-0.6	+31	+17.8	+64	+36.1	+97
-36.7	-34	-18.3	-1	0.0	+32	+18.3	+65	+36.7	+98
-36.1	-33	-17.8	0	+0.6	+33	+18.9	+66	+37.2	+99
-35.6	-32	-17.2	+1	+1.1	+34	+19.4	+67	+37.8	+100
-35.0	-31	-16.7	+2	+1.7	+35	+20.0	+68	+38.3	+101
-34.4	-30	-16.1	+3	+2.2	+36	+20.6	+69	+38.9	+102
-33.9	-29	-15.6	+4	+2.8	+37	+21.1	+70	+39.4	+103
-33.3	-28	-15.0	+5	+3.3	+38	+21.7	+71	+40.0	+104
-32.8	-27	-14.4	+6	+3.9	+39	+22.2	+72	+40.6	+105
-32.2	-26	-13.9	+7	+4.4	+40	+22.8	+73	+41.1	+106
-31.7	-25	-13.3	+8	+5.0	+41	+23.3	+74	+41.7	+107
-31.1	-24	-12.8	+9	+5.6	+42	+23.9	+75	+42.2	+108
-30.6	-23	-12.2	+10	+6.1	+43	+24.4	+76	+42.8	+109
-30.0	-22	-11.7	+11	+6.6	+44	+25.0	+77	+43.3	+110
-29.4	-21	-11.1	+12	+7.2	+45	+25.6	+78	+43.9	+111
-28.9	-20	-10.6	+13	+7.8	+46	+26.1	+79	+44.4	+112
-28.3	-19	-10.0	+14	+8.3	+47	+26.7	+80	+45.0	+113
-27.8	-18	-9.4	+15	+8.9	+48	+27.2	+81	+45.6	+114

Chapter 5 - HOLDOVER TIME (HOT) CHARTS

5.1 General

NOTE

HOT charts in this manual are for training purposes only. Current HOT tables refer to the FAA website
www.faa.gov. **Use the search option, type in "FAA Holdover Time Tables".**

A. Various deicing charts/tables are provided to allow for quick interpretation of deicing information.

B. The following charts/tables will be utilized for applying the correct information during icing conditions.

1. Snowfall Intensity - Visibility Table
2. Holdover Charts Type I Fluid
3. Holdover Charts Type II Fluid
4. Holdover Charts Type III Fluid
5. Holdover Charts Type IV Fluid
6. Ice Pellet and Small Hail Allowance Times

NOTE

HOTs and/or allowance times have not been established for heavy ice pellets, moderate and heavy freezing rain, and hail.

C. Research into HOTs on deployed flaps/slats began in the winter of 2009–2010, and since 2011–2012 has included cooperative efforts with industry.

1. Data collected has provided a substantive amount of evidence that demonstrates extended flaps/slats can accelerate antiicing fluid runoff from aircraft wings, in turn negatively affecting the protection capacity of the fluid. This results in a potential safety risk.
2. The protection capacity of the fluid is affected by many elements: the aircraft design, the slope of the surface, the type of fluid, the aircraft skin and ambient temperature, the type of precipitation, the amount of fluid applied, and the effective wind.
3. To mitigate this safety risk, it was determined by the FAA and TC that adjusting the published deicing/anti-icing fluid HOTs and allowance times to 76 percent of the current published values would provide the sufficient safety margin to safely allow operations when flaps and slats are deployed prior to deicing/anti-icing.
4. Therefore, when flaps and/or slats are extended to the takeoff configuration prior to deicing/anti-icing fluid application and remain in that configuration while taxiing to takeoff, the HOT and allowance time tables identified as "Adjusted" must be used.

5. These 76 percent adjusted tables replace the 90 percent adjusted tables that were published for the winters of 2014–2015 to 2016–2017. Note that the standard HOTs and allowance times can be used if flaps and slats are deployed as close to departure as safety allows.

NOTE

Industry data indicates the possibility of increased takeoff misconfigurations when the selection of takeoff flaps is delayed later in the taxi regime. Whether an air carrier chooses to select the flaps/slats to the takeoff.

Figure 5-1 Snowfall Intensity Chart

SNOWFALL INTENSITIES AS A FUNCTION OF PREVAILING VISIBILITY

Time of Day	Temp.		Visibility in Statute Miles (Meters)									
	Degrees Celsius	Degrees Fahrenheit	≥ 2 1/2 (≥ 4000)	2 (3200)	1 3/4 (2800)	1 1/2 (2400)	1 1/4 (2000)	1 (1600)	3/4 (1200)	1/2 (800)	≤ 1/4 (≤ 400)	
Day	colder/equal -1	colder/equal 30	Very Light	Very Light	Very Light	Light	Light	Light	Moderate	Moderate	Heavy	Snowfall Intensity
	warmer than -1	warmer than 30	Very Light	Light	Light	Light	Light	Moderate	Moderate	Heavy	Heavy	
Night	colder/equal -1	colder/equal 30	Very Light	Light	Light	Moderate	Moderate	Moderate	Moderate	Heavy	Heavy	
	warmer than -1	warmer than 30	Very Light	Light	Moderate	Moderate	Moderate	Moderate	Heavy	Heavy	Heavy	

NOTE 1: This table is for estimating snowfall intensity. It is based upon the technical report, "The Estimation of Snowfall Rate Using Visibility," Rasmussen, et al., Journal of Applied Meteorology, October 1999 and additional in situ data.

NOTE 2: This table is to be used with Type I, II, III, and IV fluid guidelines.

NOTE 3: The use of Runway Visual Range (RVR) is not permitted for determining visibility used with the holdover tables.

NOTE 4: Some METARS contain tower visibility as well as surface visibility. Whenever surface visibility is available from an official source, such as a METAR, in either the main body of the METAR or in the Remarks ("RMK") section, the preferred action is to use the surface visibility value.

NOTE 5: If visibility from a source other than the METAR is used, round to the nearest visibility in the table, rounding down if it is right in between two values. For example, .6 and .625 (5/8) would both be rounded to .5 (1/2).

HEAVY = Caution—No Holdover Time Guidelines Exist

During snow conditions alone, the use of Table 40 in determining snowfall intensities does not require pilot company coordination or company reporting procedures since this table is more conservative than the visibility table used by official weather observers in determining snowfall intensities.

Because the FAA Snowfall Intensities Table, like the FMH-1 Table, uses visibility to determine snowfall intensities, if the visibility is being reduced by snow along with other forms of obscuration such as fog, haze, smoke, etc., the FAA Snowfall Intensities Table does not need to be used to estimate the snowfall intensity for HOT determination during the presence of these obscurations. Use of the FAA Snowfall Intensities as a Function of Prevailing Visibility Table under these conditions may needlessly overestimate the actual snowfall intensity. Therefore, the snowfall intensity being reported by the weather observer or automated surface observing system (ASOS), from the FMH-1 Table, may be used.

6. Configuration prior to beginning the anti-icing process, operators should have robust procedures in place to ensure that the aircraft is properly configured prior to takeoff.

7. Air carriers should follow the manufacturer's recommended procedures regarding anti-icing operations and the configuration of flaps/slats while taxiing.

5.2 Operations in Heavy Snow

A. Tactile and Visual Checks of Aircraft. No holdover times (HOT) exist for heavy snow conditions in the current HOT tables. Review of existing data from past testing has indicated takeoffs may be safely conducted with proper tactile and/or visual checks, as appropriate for the aircraft, and a determination that the fluid has not failed. A tactile and/or visual check in heavy snow conditions must be accomplished in a manner that provides an assessment that can be accurately accomplished. It is imperative that the tactile and/or visual check procedures to determine if the anti-icing fluid has failed in heavy snow conditions be at least as comprehensive as the authorized procedures for the operator's pretakeoff contamination check (when HOTs have been exceeded) for those precipitation conditions for which HOTs exist. Anti-icing fluids dissolve the snow and absorb the resulting moisture into the fluid. When the fluid begins to fail it starts to change in appearance (e.g., less glossy and more opaque) and the snow starts to accumulate on and in the fluid. At this stage, the fluid has failed and takeoff is not authorized.

B. Takeoff in Heavy Snow Conditions. ABX Air aircraft will be allowed to takeoff in heavy snow conditions subject to the following restrictions:

1. The aircraft must be anti-iced with undiluted Type IV fluid.

2. The aircraft critical surfaces must be free of contaminants, or the aircraft must be properly deiced before the application of the anti-icing fluid.

3. When appropriate, Flight Crewmember or, if necessary, qualified Deice Personnel must accomplish an approved tactile and/or visual check of the aircraft critical surfaces within 5 minutes of takeoff.

4. If this check is accomplished visually from within the aircraft, the view must be such that it is not obscured by de/anti-icing fluid, dirt, or fogging. If the critical surfaces cannot be seen due to snowfall, distance from the viewing position, or inadequate lighting, or for any other reason, the check must be a visual or tactile check conducted from outside the aircraft.

5. If a definitive fluid failure determination cannot be made using the checks prescribed, takeoff is not authorized. The aircraft must be completely deiced, and if precipitation is still present, anti-iced again before a subsequent takeoff.

NOTE

Current aircraft certification standards only require testing of flight instrument sensing devices and engine anti-icing systems in moderate snow levels. Ground operations in heavy snow conditions may exceed the capabilities or limitations of these system and devices to adequately provide anti-icing.

5.3 Holdover Charts Type I Fluid

A. The Type I holdover charts are used to determine how long Type I deicing/anti-icing fluid can reasonably be expected to prevent the reformation of ice, snow, and frost on the aircraft's surface.

1. These times are very conservative, and can be interpreted to be the minimum amount of time that the deice/anti-ice fluid will be effective.

2. The holdover time begins when the anti-ice applications begins.

B. The Type I holdover charts apply to both ethylene glycol and propylene glycol solution. The qualified deicing person is responsible for determining that the mixture of Type I fluid will be adequate for the OAT.

C. To use the charts, determine the prevailing conditions and the ambient temperature. This information can be obtained from the ATIS frequency and weather sequences for the departure airport.

D. Each chart is based on prevailing conditions, and will also list ambient temperatures and either temperature/dew point spread, rates of snow fall, classification of precipitation, or visibility.

E. For example, to find the holdover time for Type I fluid with freezing fog use the FREEZING FOG column on the holdover chart.

1. Determine the ambient temperature.

2. The holdover time for moderate freezing fog can now be referenced.

CAUTION

HOLDOVER CHARTS/TABLES ARE FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

CAUTION

TYPE I DEICING FLUID MUST BE HEATED TO A MINIMUM OF 140° F BUT MUST NOT EXCEED 200° F BEFORE DEICE/ANTI-ICE CAN BEGIN.

CAUTION

DO NOT USE TYPE I FLUID HOLDOVER TIME GUIDELINES WHEN USING THE FORCED AIR AND GLYCOL MODE WHICH IS FOR DEICING ONLY. TO USE THE TYPE I HOLDOVER TIMES, THE AIRCRAFT MUST BE ANTI-ICED USING THE CONVENTIONAL TRUCK AND FLUID MUST BE HOT AND USED IN SUFFICIENT QUANTITY TO HEAT THE WINGS.

Figure 5-2 Active Frost HOT for Type I, II, III and IV Fluids

ACTIVE FROST HOLDOVER TIMES FOR SAE TYPE I, TYPE II, TYPE III, AND TYPE IV FLUIDS

Outside Air Temperature[1,2,3]	Type I
-1 °C and above (30 °F and above)	0:45 *(0:35)*[5]
below -1 to -3 °C (below 30 to 27 °F)	
below -3 to -10 °C (below 27 to 14 °F)	
below -10 to -14 °C (below 14 to 7 °F)	
below -14 to -21 °C (below 7 to -6 °F)	
below -21 to -25 °C (below -6 to -13 °F)	
below -25 °C to LOUT (below -13 °F to LOUT)	

Outside Air Temperature[2,3]	Concentration Fluid/Water By % Volume	Type II	Type III[4]	Type IV
-1 °C and above (30 °F and above)	100/0	8:00	2:00	12:00
	75/25	5:00	1:00	5:00
	50/50	3:00	0:30	3:00
below -1 to -3 °C (below 30 to 27 °F)	100/0	8:00	2:00	12:00
	75/25	5:00	1:00	5:00
	50/50	1:30	0:30	3:00
below -3 to -10 °C (below 27 to 14 °F)	100/0	8:00	2:00	10:00
	75/25	5:00	1:00	5:00
below -10 to -14 °C (below 14 to 7 °F)	100/0	6:00	2:00	6:00
	75/25	1:00	1:00	1:00
below -14 to -21 °C (below 7 to -6 °F)	100/0	6:00	2:00	6:00
below -21 to -25 °C (below -6 to -13 °F)	100/0	2:00	2:00	4:00
below -25 °C (below -13 °F)	100/0	No Holdover Time Guidelines Exist		

NOTES

1. Type I Fluid / Water Mixture must be selected so that the freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature.
2. Ensure that the lowest operational use temperature (LOUT) is respected.
3. Changes in outside air temperature (OAT) over the course of longer frost events can be significant; the appropriate holdover time to use is the one provided for the coldest OAT that has occurred in the time between the de/anti-icing fluid application and takeoff.
4. To use the Type III fluid frost holdover times, the fluid brand being used must be known. AllClear AeroClear MAX must be applied unheated.
5. Value in parentheses is for aircraft with critical surfaces that are predominantly or entirely constructed of composite materials.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-3 Adjusted Active Frost HOT for Type I, II, III, IV Fluids

ADJUSTED ACTIVE FROST HOLDOVER TIMES FOR SAE TYPE I, TYPE II, TYPE III, AND TYPE IV FLUIDS

Outside Air Temperature[1,2,3]	Type I
-1 °C and above (30 °F and above)	0:34 *(0:26)*[5]
below -1 to -3 °C (below 30 to 27 °F)	
below -3 to -10 °C (below 27 to 14 °F)	
below -10 to -14 °C (below 14 to 7 °F)	
below -14 to -21 °C (below 7 to -6 °F)	
below -21 to -25 °C (below -6 to -13 °F)	
below -25 °C to LOUT (below -13 °F to LOUT)	

Outside Air Temperature[2,3]	Concentration Fluid/Water By % Volume	Type II	Type III[4]	Type IV
-1 °C and above (30 °F and above)	100/0	6:04	1:31	9:07
	75/25	3:48	0:45	3:48
	50/50	2:16	0:22	2:16
below -1 to -3 °C (below 30 to 27 °F)	100/0	6:04	1:31	9:07
	75/25	3:48	0:45	3:48
	50/50	1:08	0:22	2:16
below -3 to -10 °C (below 27 to 14 °F)	100/0	6:04	1:31	7:36
	75/25	3:48	0:45	3:48
below -10 to -14 °C (below 14 to 7 °F)	100/0	4:33	1:31	4:33
	75/25	0:45	0:45	0:45
below -14 to -21 °C (below 7 to -6 °F)	100/0	4:33	1:31	4:33
below -21 to -25 °C (below -6 to -13 °F)	100/0	1:31	1:31	3:02
below -25 °C (below -13 °F)	100/0	No Holdover Time Guidelines Exist		

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 Type I Fluid / Water Mixture must be selected so that the freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 Changes in outside air temperature (OAT) over the course of longer frost events can be significant; the appropriate holdover time to use is the one provided for the coldest OAT that has occurred in the time between the de/anti-icing fluid application and takeoff.
4 To use the Type III fluid frost holdover times, the fluid brand being used must be known. AllClear AeroClear MAX must be applied unheated.
5 Value in parentheses is for aircraft with critical surfaces that are predominantly or entirely constructed of composite materials.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-4 HOT for Type I Fluid on Aluminum Critical Surfaces

HOLDOVER TIMES FOR SAE TYPE I FLUID ON CRITICAL AIRCRAFT SURFACES COMPOSED PREDOMINANTLY OF ALUMINUM

Outside Air Temperature[1,2]	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[3,4]	Light Snow, Snow Grains or Snow Pellets[3,4]	Moderate Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[5]	Light Freezing Rain	Rain on Cold Soaked Wing[6]	Other[7]
-3 °C and above (27 °F and above)	0:11 - 0:17	0:18 - 0:22	0:11 - 0:18	0:06 - 0:11	0:09 - 0:13	0:02 - 0:05	0:02 - 0:05	CAUTION: No holdover time guidelines exist
below -3 to -6 °C (below 27 to 21 °F)	0:08 - 0:13	0:14 - 0:17	0:08 - 0:14	0:05 - 0:08	0:05 - 0:09	0:02 - 0:05		
below -6 to -10 °C (below 21 to 14 °F)	0:06 - 0:10	0:11 - 0:13	0:06 - 0:11	0:04 - 0:06	0:04 - 0:07	0:02 - 0:05		
below -10 °C (below 14 °F)	0:05 - 0:09	0:07 - 0:08	0:04 - 0:07	0:02 - 0:04				

NOTES

1. Type I fluid / water mixture must be selected so that the freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature.
2. Ensure that the lowest operational use temperature (LOUT) is respected.
3. To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
4. Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
5. Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
6. No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
7. Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-5 Adjusted HOT for Type I Fluid on Aluminum Critial Surfaces

ADJUSTED HOLDOVER TIMES FOR SAE TYPE I FLUID ON CRITICAL AIRCRAFT SURFACES COMPOSED PREDOMINANTLY OF ALUMINUM

Outside Air Temperature[1,2]	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[3,4]	Light Snow, Snow Grains or Snow Pellets[3,4]	Moderate Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[5]	Light Freezing Rain	Rain on Cold Soaked Wing[6]	Other[7]
-3 °C and above (27 °F and above)	0:08 - 0:13	0:14 - 0:17	0:08 - 0:14	0:05 - 0:08	0:07 - 0:10	0:02 - 0:04	0:02 - 0:04	
below -3 to -6 °C (below 27 to 21 °F)	0:06 - 0:10	0:11 - 0:13	0:06 - 0:11	0:04 - 0:06	0:04 - 0:07	0:02 - 0:04	CAUTION: No holdover time guidelines exist	
below -6 to -10 °C (below 21 to 14 °F)	0:05 - 0:08	0:08 - 0:10	0:05 - 0:08	0:03 - 0:05	0:03 - 0:05	0:02 - 0:04		
below -10 °C (below 14 °F)	0:04 - 0:07	0:05 - 0:06	0:03 - 0:05	0:02 - 0:03				

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 Type I fluid / water mixture must be selected so that the freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
5 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
6 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

NOTE

FAA Type I HOT Guidelines are not approved for use with unheated Type I Fluid Mixtures.

CAUTIONS AND NOTES FOR LIST OF TYPE I, TYPE II, TYPE III AND TYPE IV FLUIDS TESTED Ref. N8900.636, Page 3 of the notice.

5.4 Holdover Charts Type II Fluid

A. Type II holdover charts are similar to Type I charts, but are separated by mixture.

B. There are three different mixtures on Type II fluid charts:

1. 100% mixture
2. 75% mixture
3. 50% mixture

C. To use the chart, determine the mixture of the Type II fluid in use, as well as the prevailing weather conditions and ambient temperatures. This information can be obtained from the ATIS frequency weather sequences for the departure airport. SAE Type II Fluid may be used below -25°C provided the freeze point of the fluid is at least 7°C below the OAT and the aerodynamic acceptance criteria are met. Consider use of SAE Type I Fluids when SAE Type II cannot be used.

D. Each chart is based on prevailing conditions, and will also list ambient temperatures and either temperature/dew point spread, rates of snow fall, classification of precipitation, or visibility.

E. For example, to find the holdover time for 75% Type II fluid with light snow and ambient temperature of -6° C, reference the Snowfall Intensity-Visibility Table to determine the rate of snowfall and use the 75/25 TYPE II SNOW column on the holdover chart.

1. Find the temperature range that includes -6° C on the left side of the chart, and go to the right to the proper Snowfall Rate column.
2. The holdover time for snow can now be referenced.

CAUTION

HOLDOVER CHARTS/TABLES ARE FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRE-TAKEOFF CHECK PROCEDURES.

GENERIC HOLDOVER TIMES FOR SAE TYPE II FLUIDS

Outside Air Temperature[1]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets[2,3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 °C and above (27 °F and above)	100/0	0:55 - 1:50	0:25 - 0:50	0:30 - 1:00	0:20 - 0:35	0:08 - 0:45	
	75/25	0:25 - 0:55	0:15 - 0:25	0:15 - 0:40	0:10 - 0:20	0:04 - 0:25	
	50/50	0:15 - 0:25	0:05 - 0:10	0:08 - 0:15	0:06 - 0:09	CAUTION: No holdover time guidelines exist	
below -3 to -8 °C (below 27 to 18 °F)	100/0	0:30 - 1:05	0:20 - 0:35	0:20 - 0:45	0:15 - 0:20		
	75/25	0:25 - 0:50	0:10 - 0:20	0:15 - 0:25	0:08 - 0:15		
below -8 to -14 °C (below 18 to 7 °F)	100/0	0:30 - 1:05	0:15 - 0:30	0:20 - 0:45[7]	0:15 - 0:20[7]		
	75/25	0:25 - 0:50	0:08 - 0:20	0:15 - 0:25[7]	0:08 - 0:15[7]		
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:15 - 0:35	0:06 - 0:20				
below -18 to -25 °C (below 0 to -13 °F)	100/0	0:15 - 0:35[8]	0:02 - 0:09[8]				
below -25 °C to LOUT (below -13 °F to LOUT)	100/0	0:15 - 0:35[8]	0:01 - 0:06[8]				

Figure 5-6 Generic Holdover Times For Type II Fluids

NOTES

1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type II fluid cannot be used.
2 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
7 No holdover time guidelines exist for this condition below -10 °C (14 °F).
8 If the LOUT is unknown, no holdover time guidelines exist below -24 °C (-11 °F).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-7 Adjusted Generic HOT for Type II Fluids

ADJUSTED GENERIC HOLDOVER TIMES FOR SAE TYPE II FLUIDS

Outside Air Temperature[1]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Snow, Snow Grains or Snow Pellets[2,3]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 °C and above (27 °F and above)	100/0	0:42 - 1:20	0:19 - 0:38	0:27 - 0:49	0:19 - 0:27	0:05 - 0:34	
	75/25	0:19 - 0:42	0:11 - 0:19	0:11 - 0:30	0:08 - 0:15	0:03 - 0:19	
	50/50	0:11 - 0:19	0:04 - 0:08	0:06 - 0:11	0:05 - 0:07		
below -3 to -14 °C (below 27 to 7 °F)	100/0	0:23 - 0:49	0:11 - 0:23	0:15 - 0:34[7]	0:11 - 0:15[7]		
	75/25	0:19 - 0:38	0:06 - 0:15	0:11 - 0:19[7]	0:06 - 0:11[7]		
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:11 - 0:27	0:05 - 0:15	CAUTION: No holdover time guidelines exist			
below -18 to -25 °C (below 0 to -13 °F)	100/0	0:11 - 0:27	0:02 - 0:07				
below -25 °C to LOUT (below -13 °F to LOUT)	100/0	0:11 - 0:27[8]	0:01 - 0:05[8]				

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type II fluid cannot be used.
2 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4 Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.
7 No holdover time guidelines exist for this condition below -10 °C (14 °F).
8 If the LOUT is unknown, no holdover time guidelines exist below -25 °C (-13 °F).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

5.5 Holdover Charts Type III Fluid

A. Type III holdover charts are similar to Type II charts in format, however, each chart is:

1. Fluid Specific

2. Application Temperature Specific

3. Rotation Speed Profile Specific (High or Low Speed Aerodynamic Criterion).

   a. ABX Air aircraft operate under the High Speed Type III Holdover Time Guidelines based on Aerodynamic Criterion conforming to SAE AS5900.

   b. This includes guidelines for the existing Type III fluid Clariant Safewing MP III 2031 ECO (applied heated) and for the new Type III fluid AllClear AeroClear MAX (applied unheated).

B. Due to the different application temperature requirements of the two Type III fluids, it is not possible to determine generic Type III holdover times. As a result, the Type III generic HOT guideline has been removed. Users must know which fluid brand is being used and use the appropriate Type III fluid-specific HOT guidelines when using Type III fluid.

C. To use the chart, determine the fluid brand and, if applicable, the mixture of the Type III fluid in use, as well as the prevailing weather conditions and ambient temperatures. This information can be obtained from the ATIS frequency and weather sequences of the departure airport. SAE Type III Fluid may be used below -10°C provided the freeze point of the fluid is at least 7°C below the OAT and the aerodynamic acceptance criteria are met. Consider use of SAE Type I Fluids when SAE Type III cannot be used.

D. Each chart is based on prevailing conditions, and will also list ambient temperatures and classification of precipitation.

E. For example, to find the holdover time for 75% Clariant Safewing MP III 2031 ECO Type III fluid for a High Speed Profile aircraft with light snow and ambient temperature of -6° C, reference High Speed Clariant Safewing MP III 2031 ECO Type III Holdover Time Chart.

1. Find the temperature range that includes -6° C on the left side of the chart, and go to the right to the proper Type III Fluid Concentration, then continue further right to the Snowfall Rate column.

2. The holdover time for LIGHT snow can now be referenced.

CAUTION

HOLDOVER CHARTS/TABLES ARE FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRE-TAKEOFF CHECK PROCEDURES.

Figure 5-8 Type III HOT for AllClear and Aeroclear Max Applied Unheated on High Speed Aircraft

TYPE III HOLDOVER TIMES FOR ALLCLEAR AEROCLEAR MAX APPLIED UNHEATED ON HIGH SPEED AIRCRAFT[1]

Outside Air Temperature[2]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[3,4]	Light Snow, Snow Grains or Snow Pellets[3,4]	Moderate Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[5]	Light Freezing Rain	Rain on Cold Soaked Wing[6]	Other[7]
-3 °C and above (27 °F and above)	100/0	0:45 - 1:55	1:20 - 1:45	0:40 - 1:20	0:18 - 0:40	0:25 - 0:50	0:14 - 0:25	0:05 - 0:40	CAUTION: No holdover time guidelines exist
	75/25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	50/50	N/A	N/A	N/A	N/A	N/A	N/A		
below -3 to -10 °C (below 27 to 14 °F)	100/0	0:50 - 1:40	1:20 - 1:45	0:40 - 1:20	0:18 - 0:40	0:25 - 0:45	0:15 - 0:25		
	75/25	N/A	N/A	N/A	N/A	N/A	N/A		
below -10 to -25 °C (below 14 to -13 °F)	100/0	0:40 - 1:45	1:20 - 1:45	0:40 - 1:20	0:18 - 0:40				
below -25 to -35 °C (below -13 to -31 °F)	100/0	0:25 - 1:00	0:45 - 1:00	0:20 - 0:45	0:10 - 0:20				

NOTES

1 These holdover times are for aircraft conforming to the SAE AS5900 high speed aerodynamic test criterion. Fluid must be applied unheated to use these holdover times. No holdover times exist for this fluid applied heated.
2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type III fluid cannot be used.
3 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
5 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
6 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 38 provides allowance times for ice pellets and small hail for SAE Type III fluids, applied unheated).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-9 Adjusted Type III HOT for Allclear and Aeroclear Max Applied Unheated on High Speed Aircraft

ADJUSTED TYPE III HOLDOVER TIMES FOR ALLCLEAR AEROCLEAR MAX APPLIED UNHEATED ON HIGH SPEED AIRCRAFT[1]

Outside Air Temperature[2]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[3,4]	Light Snow, Snow Grains or Snow Pellets[3,4]	Moderate Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[5]	Light Freezing Rain	Rain on Cold Soaked Wing[6]	Other[7]
-3 °C and above (27 °F and above)	100/0	0:34 - 1:27	1:01 - 1:20	0:30 - 1:01	0:14 - 0:30	0:19 - 0:38	0:11 - 0:19	0:04 - 0:30	CAUTION: No holdover time guidelines exist
	75/25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	50/50	N/A	N/A	N/A	N/A	N/A	N/A		
below -3 to -10 °C (below 27 to 14 °F)	100/0	0:38 - 1:16	1:01 - 1:20	0:30 - 1:01	0:14 - 0:30	0:19 - 0:34	0:11 - 0:19		
	75/25	N/A	N/A	N/A	N/A	N/A	N/A		
below -10 to -25 °C (below 14 to -13 °F)	100/0	0:30 - 1:20	1:01 - 1:20	0:30 - 1:01	0:14 - 0:30				
below -25 to -35 °C (below -13 to -31 °F)	100/0	0:19 - 0:46	0:34 - 0:46	0:15 - 0:34	0:08 - 0:15				

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 These holdover times are for aircraft conforming to the SAE AS5900 high speed aerodynamic test criterion. Fluid must be applied unheated to use these holdover times. No holdover times exist for this fluid applied heated.
2 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type III fluid cannot be used.
3 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
5 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
6 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table ADJ-38 provides allowance times for ice pellets and small hail for SAE Type III fluids, applied unheated).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

5.6 Holdover Charts Type IV Fluid

A. Type IV holdover charts are similar to Type II charts, and are separated by mixture.

B. There are three different mixtures on Type IV fluid charts:

1. 100% mixture
2. 75% mixture
3. 50% mixture

C. To use the chart, determine the mixture of the Type IV fluid in use, as well as the prevailing weather conditions and ambient temperatures. This information can be obtained from the ATIS frequency and the weather sequences of the departure airport. SAE Type IV Fluid may be used below -25°C provided the freeze point of the fluid is at least 7°C below the OAT and the aerodynamic acceptance criteria are met. Consider use of SAE Type I Fluids when SAE Type IV cannot be used.

D. Each chart is based on prevailing conditions, and will also list ambient temperatures and either temperature/dew point spread, rates of snow fall, classification of precipitation, or visibility.

E. For example, to find the holdover time for 75% Type IV fluid with light snow and ambient temperature of -6° C, reference the Snowfall Intensity-Visibility Table to determine the rate of snowfall and use the 75/25 TYPE IV SNOW column on the holdover chart.

1. Find the temperature range that includes -6° C on the left side of the chart, and go to the right to the proper Snowfall Rate column.
2. The holdover time for snow can now be referenced.

> CAUTION
>
> **HOLDOVER CHARTS/TABLES ARE FOR DEPARTURE PLANNING ONLY AND SHOULD BE USED IN CONJUNCTION WITH PRE-TAKEOFF CHECK PROCEDURES.**

F. Information has been published by the FAA and Boeing about a phenomenon concerning Type IV (and possibly Type II) anti-icing fluids called **fluid dry-out**. Where there is little or no airflow to cause fluid shear to take place, the fluid remains on the aircraft in what are called **aerodynamically quiet areas**. These areas are generally wing roots, flap wells, balanced bays, rear spar areas, or crevices. Since these areas are **aerodynamically quiet areas**, the residual fluid left on the aircraft causes no performance degradation. It's not uncommon to see a certain amount of Type IV or Type II fluid dripping out of these **aerodynamically quiet areas** after the aircraft was anti-iced and then subsequently flown to its destination. When Type IV or Type II fluid eventually dries out, it will form a powdery looking substance that's easily washed or brushed off. This is referred to as **fluid dry-out**. When there are repeated dry surface applications of Type IV (or possibly Type II) fluids **without an intervening Type I deicing/anti-icing fluid or hot water application**, this powdery reside can accumulate in these **aerodynamically quiet areas**. Large amounts of this powdery residue have been known to rehydrate and expand under certain atmospheric conditions, such as high humidity or rain, and then subsequently freeze at high altitudes and extremely cold temperatures. To increase awareness of this potential problem, all Deicing Personnel will be trained and instructed to pay close attention to the **aerodynamically quiet areas** of the aircraft.

Figure 5-10 Generic HOT For Type IV Fluids

GENERIC HOLDOVER TIMES FOR SAE TYPE IV FLUIDS

Outside Air Temperature[1]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[2,3]	Light Snow, Snow Grains or Snow Pellets[2,3]	Moderate Snow, Snow Grains or Snow Pellets[2]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 °C and above (27 °F and above)	100/0	1:15 - 2:40	2:20 - 2:45	1:10 - 2:20	0:35 - 1:10	0:40 - 1:30	0:25 - 0:40	0:08 - 1:10	CAUTION: No holdover time guidelines exist
	75/25	1:25 - 2:40	2:05 - 2:25	1:15 - 2:05	0:40 - 1:15	0:50 - 1:20	0:30 - 0:45	0:09 - 1:15	
	50/50	0:30 - 0:55	1:00 - 1:10	0:25 - 1:00	0:10 - 0:25	0:15 - 0:40	0:09 - 0:20		
below -3 to -8 °C (below 27 to 18 °F)	100/0	0:20 - 1:35	1:50 - 2:20	0:55 - 1:50	0:30 - 0:55	0:25 - 1:20	0:20 - 0:25		
	75/25	0:30 - 1:20	1:50 - 2:10	1:00 - 1:50	0:30 - 1:00	0:20 - 1:05	0:15 - 0:25		
below -8 to -14 °C (below 18 to 7 °F)	100/0	0:20 - 1:35	1:20 - 1:40	0:45 - 1:20	0:25 - 0:45	0:25 - 1:20[7]	0:20 - 0:25[7]		
	75/25	0:30 - 1:20	1:40 - 2:00	0:45 - 1:40	0:20 - 0:45	0:20 - 1:05[7]	0:15 - 0:25[7]		
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:20 - 0:40	0:40 - 0:50	0:20 - 0:40	0:06 - 0:20				
below -18 to -25 °C (below 0 to -13 °F)	100/0	0:20 - 0:40[8]	0:20 - 0:25[8]	0:09 - 0:20[8]	0:02 - 0:09[8]				
below -25 °C to LOUT (below -13 °F to LOUT)	100/0	0:20 - 0:40[8]	0:20 - 0:25[8]	0:06 - 0:20[8]	0:01 - 0:06[8]				

NOTES

1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type IV fluid cannot be used.
2 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table 39 provides allowance times for ice pellets and small hail).
7 No holdover time guidelines exist for this condition below -10 °C (14 °F).
8 If the LOUT is unknown, no holdover time guidelines exist below -22.5 °C (-8.5 °F).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

Figure 5-11 Adjusted Generic HOT For Type IV Fluids

ADJUSTED GENERIC HOLDOVER TIMES FOR SAE TYPE IV FLUIDS

Outside Air Temperature[1]	Fluid Concentration Fluid/Water By % Volume	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[2,3]	Light Snow, Snow Grains or Snow Pellets[2,3]	Moderate Snow, Snow Grains or Snow Pellets[2]	Freezing Drizzle[4]	Light Freezing Rain	Rain on Cold Soaked Wing[5]	Other[6]
-3 °C and above (27 °F and above)	100/0	0:57 - 2:02	1:46 - 2:05	0:53 - 1:46	0:27 - 0:53	0:30 - 1:08	0:19 - 0:30	0:06 - 0:53	
	75/25	1:05 - 2:02	1:35 - 1:50	0:57 - 1:35	0:30 - 0:57	0:38 - 1:01	0:23 - 0:34	0:07 - 0:57	
	50/50	0:23 - 0:42	0:46 - 0:53	0:19 - 0:46	0:08 - 0:19	0:11 - 0:30	0:07 - 0:15		
below -3 to -8 °C (below 27 to 18 °F)	100/0	0:15 - 1:12	1:24 - 1:46	0:42 - 1:24	0:23 - 0:42	0:19 - 1:01	0:15 - 0:19		
	75/25	0:23 - 1:01	1:24 - 1:39	0:46 - 1:24	0:23 - 0:46	0:15 - 0:49	0:11 - 0:19		
below -8 to -14 °C (below 18 to 7 °F)	100/0	0:15 - 1:12	1:01 - 1:16	0:34 - 1:01	0:19 - 0:34	0:19 - 1:01[7]	0:15 - 0:19[7]	CAUTION: No holdover time guidelines exist	
	75/25	0:23 - 1:01	1:16 - 1:31	0:34 - 1:16	0:15 - 0:34	0:15 - 0:49[7]	0:11 - 0:19[7]		
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:15 - 0:30	0:30 - 0:38	0:15 - 0:30	0:05 - 0:15				
below -18 to -25 °C (below 0 to -13 °F)	100/0	0:15 - 0:30[8]	0:15 - 0:19[8]	0:07 - 0:15[8]	0:02 - 0:07[8]				
below -25° C to LOUT (below -13° F to LOUT)	100/0	0:15 - 0:30[8]	0:15 - 0:19[8]	0:05 - 0:15[8]	0:01 - 0:05[8]				

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 Ensure that the lowest operational use temperature (LOUT) is respected. Consider use of Type I fluid when Type IV fluid cannot be used.
2 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
3 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
4 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
5 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
6 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (Table ADJ-39 provides allowance times for ice pellets and small hail).
7 No holdover time guidelines exist for this condition below -10 °C (14 °F).
8 If the LOUT is unknown, no holdover time guidelines exist below -22.5 °C (-8.5 °F).

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

5.7 Possible Effects of Runway Deicer on Thickened Aircraft Anti- Icing Fluids

A. Most current runway deicing/anti-icing material contains organic salts that are not compatible with thickened aircraft anti-icing fluids. These salts cause the thickening agents within the aircraft deicing fluids to break down, reducing the viscosity of the anti-icing fluid and causing it to flow off the airframe more quickly. This reduction in the amount of anti-icing fluid will have an impact on the length of time that the antiicing fluid will continue to provide adequate anti-icing protection.

B. During landing, if runway deicing fluid is expected to have been splashed or blown up onto a critical surface, those surfaces should be thoroughly washed with deicing fluid or hot water (if temperature appropriate) prior to applying anti-icing fluids. This is normally accomplished during a routine two-step deicing/anti-icing process; however, during a preventive anti-icing fluid application, this cleansing step is often not accomplished. During taxi operation for takeoff on taxiways that have been deiced/anti-iced, flight crews should be conscious of the effects of having the runway deicing fluid blown up onto the aircraft be preceding aircraft jet blast.

5.8 Ice Pellet and Small Hail Allowance Times

ABX Air will be allowed, in the specified ice pellet and small hail conditions and corresponding outside air temperatures (OAT) listed in Ice Pellet and Small Hail Allowance Times table, up to the specific allowance time listed in Ice Pellet and Small Hail Allowance Times table after the start of the antiicing fluid application to commence the takeoff with the following restrictions:

A. The aircraft critical surfaces must be free of contaminants before applying Type III or Type IV anti-icing fluid. If not, the aircraft must be properly deiced and checked to be free to contaminants before the application of Type III or Type IV anti-icing fluid.

B. The allowance time is valid only if the aircraft is anti-iced with undiluted Type III or Type IV fluid.

C. The Type III allowance times are only applicable for un-heated antiicing fluid applications.

D. Due to the shearing qualities of Type III and Type IV fluids with imbedded ice pellets, this allowance is limited to aircraft with a rotation speed of 100 knots or greater or 115 knots as indicated in the Ice Pellet and Small Hail Allowance Times table.

E. If the takeoff is not accomplished within the applicable allowance time in the Ice Pellet and Small Hail Allowance Times table the aircraft must be completely deiced, and if precipitation is still present, anti-iced again prior to a subsequent takeoff. If the precipitation stops at or before the time limits of the applicable allowance time and does not restart, the aircraft may takeoff up to 90 minutes after the start of the application of the Type III or Type IV anti-icing fluid, however, the OAT must remain constant or increase during the 90 minute period under the following conditions:

   1. light ice pellets mixed with light or moderate freezing drizzle;

   2. light ice pellets mixed with light freezing rain;

   3. light ice pellets mixed with light rain; and

   4. light ice pellets mixed with moderate rain.

F. A pre-takeoff contamination check is not required. The allowance time cannot be extended by an internal or external check of the aircraft critical surfaces.

G. If ice pellet precipitation becomes heavier than moderate or if the light ice pellets mixed with other forms of allowable precipitation exceeds the listed intensities or temperature range, the allowance time cannot be used.

H. If the temperature decreases below the temperature on which the allowance time was based,

1. and the new lower temperature has an associated allowance time for the precipitation condition and the present time is within the new allowance time, then that new time must be used as the allowance time limit.

2. and the allowance time has expired (within the 90 minute post anti-icing window if the precipitation has stopped within the allowance time), the aircraft may not takeoff and must be completely deiced and, if applicable, anti-iced before a subsequent takeoff.

I. Ice Pellets – When ice pellets are being reported, the following chart information extracted from the Federal Meteorological Handbook shall be used to assess their actual intensity rate:

1. Light - Scattered pellets that do not completely cover an exposed surface regardless of duration.

2. Moderate - Slow accumulation on ground.

3. Heavy - Rapid accumulation on ground.

NOTE

Tests have shown that ice pellets generally remain in the frozen state imbedded in Type IV anti-icing fluid, and are not absorbed by the fluid in the same manner as other forms of precipitation. Using current guidelines for determining anti-icing fluid failure, the presence of a contaminant not absorbed by the fluid (remaining imbedded) would be an indication that the fluid has failed. These imbedded ice pellets are generally not detectable by the human eye during pre-takeoff contamination check procedures. Therefore, a visual pretakeoff contamination check in ice pellet conditions would not be of value and is not required.

Figure 5-12 Allowance Times For Type III Fluids

ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1]

Precipitation Type	Outside Air Temperature		
	-5 °C and above	Below -5 to -10 °C	Below -10 °C[2]
Light Ice Pellets	10 minutes	10 minutes	Caution: No allowance times currently exist
Light Ice Pellets Mixed with Snow	10 minutes	10 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	7 minutes	5 minutes	
Light Ice Pellets Mixed with Freezing Rain	7 minutes	5 minutes	
Light Ice Pellets Mixed with Rain	7 minutes[3]		
Moderate Ice Pellets (or Small Hail)[4]	5 minutes	5 minutes	

NOTES

1 These allowance times are for use with undiluted (100/0) fluids applied unheated on aircraft with rotation speeds of 100 knots or greater.

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

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

4 If no intensity is reported with small hail, use the “moderate ice pellets or small hail” allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the “light ice pellets” allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with snow is reported, use the “light ice pellets mixed with snow” allowance times.

CAUTIONS

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

Figure 5-13 Adjusted Allowance Times For Type III Fluids

ADJUSTED ALLOWANCE TIMES FOR SAE TYPE III FLUIDS[1]

Precipitation Type	Outside Air Temperature		
	-5 °C and above	Below -5 to -10 °C	Below -10 °C[2]
Light Ice Pellets	8 minutes	8 minutes	Caution: No allowance times currently exist
Light Ice Pellets Mixed with Snow	8 minutes	8 minutes	
Light Ice Pellets Mixed with Freezing Drizzle	5 minutes	4 minutes	
Light Ice Pellets Mixed with Freezing Rain	5 minutes	4 minutes	
Light Ice Pellets Mixed with Rain	5 minutes[3]		
Moderate Ice Pellets (or Small Hail)[4]	4 minutes	4 minutes	

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. ALLOWANCE TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 These allowance times are for use with undiluted (100/0) fluids applied unheated on aircraft with rotation speeds of 100 knots or greater.

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

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

4 If no intensity is reported with small hail, use the “moderate ice pellets or small hail” allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the “light ice pellets” allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with snow is reported, use the “light ice pellets mixed with snow” allowance times.

CAUTIONS

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

Figure 5-14 Allowance Time For Types IV Fluids

ALLOWANCE TIMES FOR SAE TYPE IV FLUIDS[1]

Precipitation Type	Outside Air Temperature			
	-5 °C and above	Below -5 to -10 °C	Below -10 to -16 °C	Below -16 to -22 °C[2]
Light Ice Pellets	50 minutes	30 minutes	30 minutes[3]	30 minutes[3]
Light Ice Pellets Mixed with Snow	40 minutes	15 minutes	15 minutes[3]	Caution: No allowance times currently exist
Light Ice Pellets Mixed with Freezing Drizzle	25 minutes	10 minutes	Caution: No allowance times currently exist	
Light Ice Pellets Mixed with Freezing Rain	25 minutes	10 minutes		
Light Ice Pellets Mixed with Rain	25 minutes[4]	Caution: No allowance times currently exist		
Moderate Ice Pellets (or Small Hail)[5]	25 minutes[6]	10 minutes	10 minutes[3]	10 minutes[7]
Moderate Ice Pellets (or Small Hail)[5] Mixed with Freezing Drizzle	10 minutes	7 minutes	Caution: No allowance times currently exist	
Moderate Ice Pellets (or Small Hail)[5] Mixed with Rain	10 minutes[8]			

NOTES

1 These allowance times are for use with undiluted (100/0) fluids applied on aircraft with rotation speeds of 100 knots or greater. All Type IV fluids are propylene glycol based with the exception of CHEMCO ChemR EG IV, Clariant Max Flight AVIA, Clariant Safewing EG IV NORTH, Dow EG106, LNT Solutions E450 and Oksayd Defrost EG 4, which are ethylene glycol based.

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

3 No allowance times exist for propylene glycol (PG) fluids when used on aircraft with rotation speeds less than 115 knots. (For these aircraft, if the fluid type is not known, assume zero allowance time.)

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

5 If no intensity is reported with small hail, use the "moderate ice pellets or small hail" allowance times. If an intensity is reported with small hail, the ice pellet condition with the equivalent intensity can be used, e.g. if light small hail is reported, the "light ice pellets" allowance times can be used. This also applies in mixed conditions, e.g. if light small hail mixed with snow is reported, use the "light ice pellets mixed with snow" allowance times.

6 Allowance time is 15 minutes for propylene glycol (PG) fluids or when the fluid type is unknown.

7 No allowance times exist for propylene glycol (PG) fluids in this condition for temperatures below -16 °C.

8 No allowance times exist in this condition for temperatures below 0 °C.

CAUTIONS

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

Figure 5-15 ADJUSTED ALLOWANCE TIMES FOR SAE TYPE IV FLUIDS

ADJUSTED HOLDOVER TIMES FOR SAE TYPE I FLUID ON CRITICAL AIRCRAFT SURFACES COMPOSED PREDOMINANTLY OF ALUMINUM

Outside Air Temperature[1,2]	Freezing Fog or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets[3,4]	Light Snow, Snow Grains or Snow Pellets[3,4]	Moderate Snow, Snow Grains or Snow Pellets[3]	Freezing Drizzle[5]	Light Freezing Rain	Rain on Cold Soaked Wing[6]	Other[7]
-3 °C and above (27 °F and above)	0:08 - 0:13	0:14 - 0:17	0:08 - 0:14	0:05 - 0:08	0:07 - 0:10	0:02 - 0:04	0:02 - 0:04	CAUTION: No holdover time guidelines exist
below -3 to -6 °C (below 27 to 21 °F)	0:06 - 0:10	0:11 - 0:13	0:06 - 0:11	0:04 - 0:06	0:04 - 0:07	0:02 - 0:04	CAUTION: No holdover time guidelines exist	
below -6 to -10 °C (below 21 to 14 °F)	0:05 - 0:08	0:08 - 0:10	0:05 - 0:08	0:03 - 0:05	0:03 - 0:05	0:02 - 0:04		
below -10 °C (below 14 °F)	0:04 - 0:07	0:05 - 0:06	0:03 - 0:05	0:02 - 0:03	CAUTION: No holdover time guidelines exist			

THIS TABLE IS FOR USE WHEN FLAPS/SLATS ARE DEPLOYED PRIOR TO DE/ANTI-ICING. HOLDOVER TIMES HAVE BEEN ADJUSTED TO 76 PERCENT.

NOTES

1 Type I fluid / water mixture must be selected so that the freezing point of the mixture is at least 10 °C (18 °F) below outside air temperature.
2 Ensure that the lowest operational use temperature (LOUT) is respected.
3 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (Table 40) is required.
4 Use light freezing rain holdover times in conditions of very light or light snow mixed with light rain.
5 Includes light, moderate and heavy freezing drizzle. Use light freezing rain holdover times if positive identification of freezing drizzle is not possible.
6 No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.
7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail.

CAUTIONS

- The responsibility for the application of these data remains with the user.
- The time of protection will be shortened in heavy weather conditions. Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may be reduced when aircraft skin temperature is lower than outside air temperature.
- Fluids used during ground de/anti-icing do not provide in-flight icing protection.
- This table is for departure planning only and should be used in conjunction with pretakeoff check procedures.

5.9 Operations in Small Hail

A. Background

1. The World Meteorological Organization (WMO) states that the METAR code GS is used for two meteorological conditions: "snow pellets" and "small hail." In the United States and most other countries, weather observers report the METAR code GS in snow pellets and in small hail conditions, as recommended by the WMO. In Canada, weather observers only report GS in snow pellets; small hail is reported as SHGS with remarks.

2. Different HOTs/allowance times apply in these two weather conditions that may be prevailing when the METAR code GS is reported. If the weather condition is snow pellets, the snow HOTs are applicable. If the weather condition is small hail, the ice pellets and small hail allowance times are applicable. If it is unknown which of the two weather conditions is prevailing, the ice pellets and small hail allowance times are applicable, as these are more restrictive than the snow HOTs.

3. In the United States and most other countries, no intensity is reported with small hail. In some countries (e.g., Japan), an intensity is reported with small hail.

4. Hail, METAR code GR, is not the same meteorological condition as small hail, as the individual pellets are larger. There are no HOTs or allowance times for GR.

B. Operations Guidance. The following guidance should be used to ensure the correct HOTs/allowance times are used with METAR code GS:

1. If operating in the United States and METAR code GS is reported, the appropriate ice pellet and small hail allowance times should be used.

2. If operating in Canada and METAR code GS is reported, snow HOTs can be used. If operating in Canada and METAR code SHGS is reported, ice pellet and small hail allowance times should be used.

3. If operating in any other country and METAR code GS is reported, use the appropriate ice pellet and small hail allowance times unless additional information is provided with the METAR that makes clear the weather condition is snow pellets and not small hail, in which case the snow HOTs can be used.

4. If no intensity is reported with small hail, the moderate ice pellet allowance times should be used. If an intensity is reported with small hail, the allowance times for the ice pellet condition with the equivalent intensity can be used (e.g., light small hail = light ice pellets, moderate small hail = moderate ice pellets). This also applies in mixed conditions (e.g., if light small hail mixed with light snow is reported, use the "light ice pellets mixed with light snow" allowance times). The following examples illustrate the application of this guidance:

   a. If you get a report of "Small Hail" but no intensity is reported with it, you must use the "Moderate Ice Pellets" allowance times. This is shown in the row "Moderate Ice Pellets or Small Hail."

   b. If you get a report of "Small Hail" and its intensity is reported as "moderate," you must also use the "Moderate Ice Pellets or Small Hail" allowance times.

   c. If you get a report of "Small Hail" and its intensity is reported as "light," you can use the "Light Ice Pellets" allowance times.

d. If you get a report of "Small Hail" and its intensity is reported as "light" and it is mixed with another condition (e.g., snow, rain, or freezing rain), you can use the equivalent light ice pellets allowance times. For example, if you have Light Small Hail mixed with Light Rain, you can use the "Light Ice Pellets mixed with Light Rain" allowance times.

NOTE

HOTs and/or allowance times have not been established for heavy ice pellets, moderate and heavy freezing rain, and hail.

Chapter 6 - REFRACTOMETER

6.1 Glycol and Battery Tester

NOTE

The reprint below shows how the Misco Glycol Tester is used

A. MISCO 7064VP (C) and 7084VP (F) (orange) series Refractometer, Policy and Procedures

B. Description

1. The inspection and adjustment of the MISCO 7064VP and 7084VP series Deice Refractometer shall be accomplished IAW the inspection and adjustment procedures. The inspection and adjustment will be accomplished IAW the following time limits.

2. Refractometers require annual recalibration. Each unit will be sent to MISCO at 3401 Virginia Rd. Cleveland, Ohio 44122-4225. http://www.misco.com, 1-800-358-1100. MISCO will and return the ABX Air owned units with letter of certification that will remain on file.

NOTE

Daily inspections and calibration checks are preformed and recorded on refractometer calibration form for all units in service. All Inspection Records will be kept on file for a period of one year.

C. Calibration/Adjustment

1. The Duo-Check 7064VP/7084VP refractometer must be inspected to these guidelines to assure a high quality instrument with functional reliability.

2. Inspection

3. Refractometer case surface must be free of defects, cracks, deformation on vinyl cover where smooth and leather grain finish must be clean.

4. Name plate and instruction plate must be clean and legible.

5. Areas around vinyl eyecap must be free of visible cement.

6. Eyecap must be attached to the vinyl cover, and be unable to be turned.

7. Lucite cover plate must contact evenly at bottom end of glass prism and should be held against prism by spring force. Cover plate spring must operate smoothly and positive pressure to take place below horizontal position of cover plate. Pump and dip stick must be retained in channels of vinyl positively and must not fall cut during handling of the instrument.

8. Name plate and instruction plate must lie smoothly in place and be under undercut lip in all areas. Ensure that the tab of instruction plate retains pump.

9. Adjustment

WARNING

USING TAP WATER TO CHECK CALIBRATION OF THIS INSTRUMENT WILL INDICATE ERRONEOUS READINGS AND RENDER THIS TEST INVALID. USE DISTILLED WATER ONLY.

10. Specific adjustment tests are required for each type of refractometer using distilled water only.

11. Swing back the plastic cover exposing the rectangular plastic measuring window. Wipe this and the cover clean and dry with a cloth.

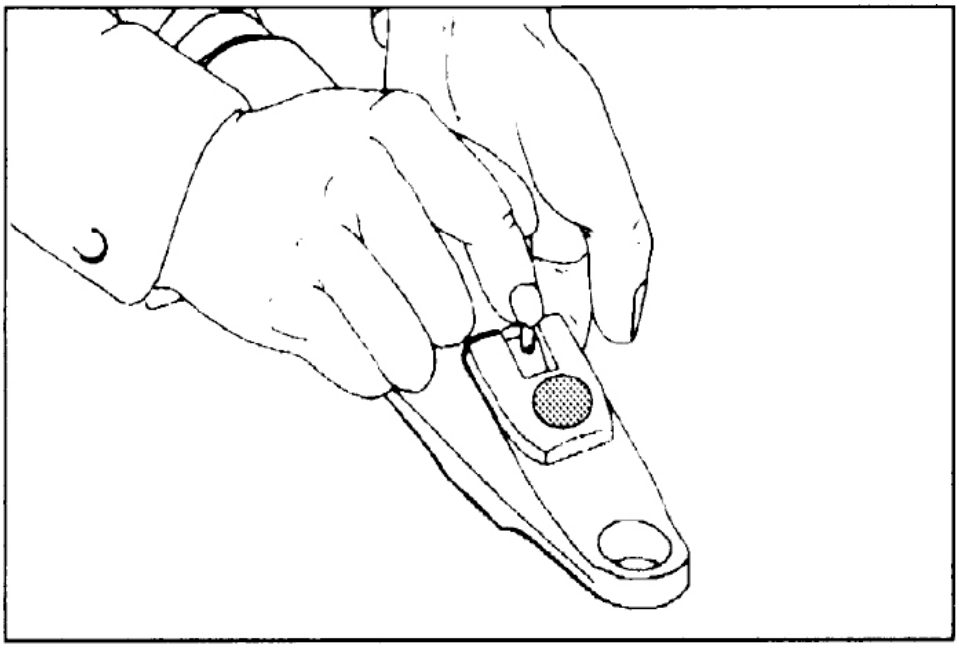
12. Insert the clear plastic hose, located on back side of refractometer, into distilled water. Press and release bulb to draw up a sample of fluid. Eject four (4) drops of distilled water onto the refractometer measuring surface by pressing the bulb and close the plastic cover. Discard the remaining distilled water from the plastic hose.

13. Look through the eyepiece and read the scale marked “Ethylene or Propylene Glycol” .

14. The measured results should be a dark line or shadow across the scale. The distilled water must read +32° F or 0°C centered within 1/4 line width. If the refractometer reads within limits, no further tests are required, and you should proceed to step 10.

D. MICSO Refractometer Model 7064VP and 7084VP

Figure 6-1



1. Operating Instructions

   a. Testing

NOTE

Do not remove clear plastic pump from tester.

1. Deicing Fluid
2. Release tip of pump from tester housing and insert into deicing fluid sample.

NOTE

Ensure tip of pump is inserted well below level of fluid.

3. Press and release bulb to draw up a sample of fluid.
4. Bend plastic tube around tester so that tip can be inserted in cover late opening.
5. Eject a few drops of deicing fluid into measuring surface by pressing bulb.

b. Reading

1. Point the instrument toward a light source and look into eyepiece.

NOTE

The freeze point protection reading is at the point where the dividing line between light and dark crosses the scale (see Figure 6-3).

NOTE

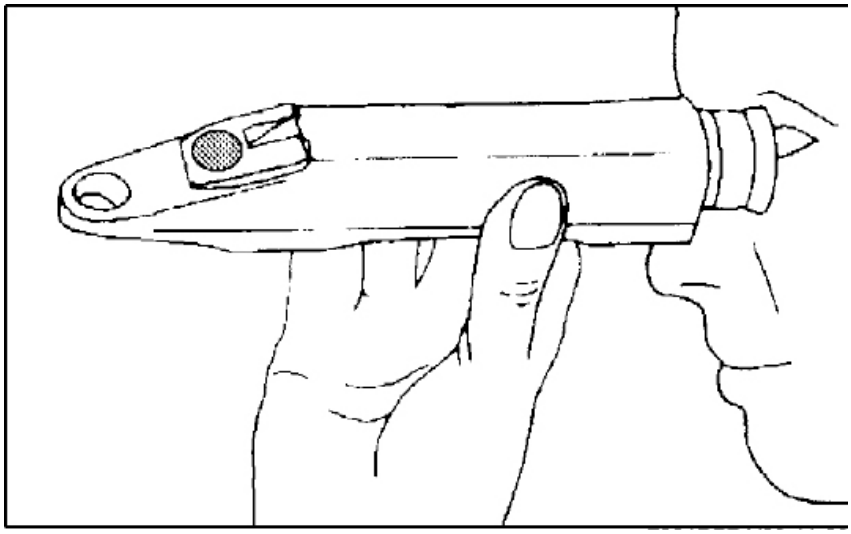
The tester temperature scale is reversed from a standard thermometer scale. Below zero readings are on upper half of scale.

NOTE

A little experience will enable you to obtain quickly the best contrast between the light and dark portions of the field of view.

2. Tilt the instrument toward the light source until best results are obtained. If the edge of the shadow is not sharp, the measuring surfaces were not sufficiently well cleaned or dried.

Figure 6-2



3. Wipe dry (ref. paragraph. 13.A.(1) and make a new test.

c. Hold the instrument in a horizontal position and swing the cover plate up to expose both the measuring prism and the bottom surface of the cover plate. After cleaning exposed surfaces as required, place a drop or two of the sample on the prism using the dip stick provided.

NOTE

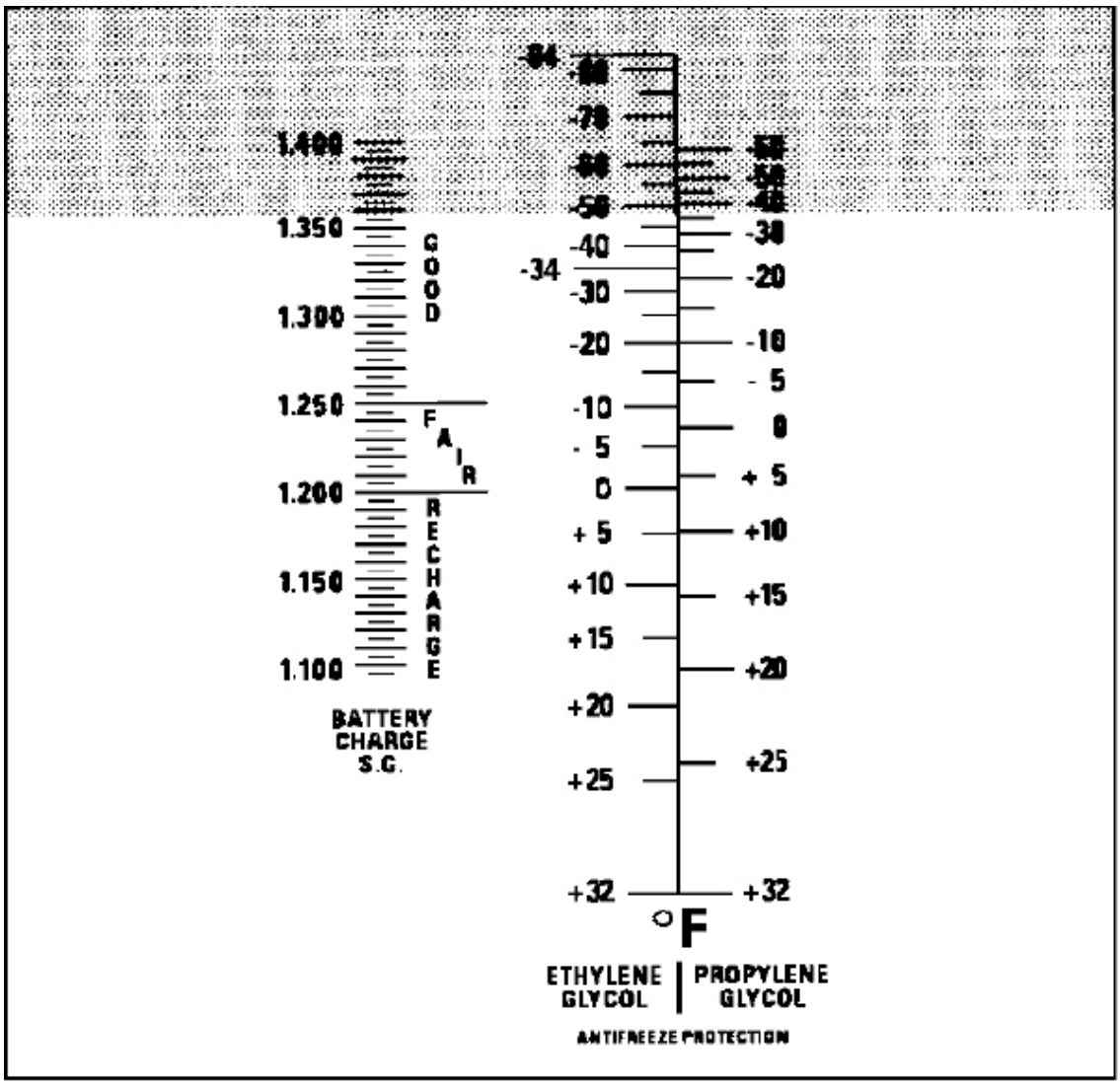
Be careful not to scratch or damage the viewing window.

d. To reduce evaporation to minimum, close the cover plate over the prism without delay, particularly if substances over 40° Brix are measured.

e. Take the reading at the point where the dividing line between light and dark fields cross the scale.

f. If the "shadow-line" is not sharp, the sample may not be sufficiently mixed. Should this be the case, the reading is often improved by lifting the cover plate very slightly and pushing it down again. Repeat two or three times (substances containing oils or fat in suspension do not give sharp shadow-lines).

Figure 6-3 Refractometer Scale



g. Use a soft cloth or soft tissue paper, moistened with water, for wiping the prism on the bottom surfaces of the cover plate. Dry the surfaces with a soft cloth or tissue paper. If the surfaces are not well cleaned before the next sample is loaded, an erroneous or fuzzy reading may result. Do not immerse the eyepiece in water. Never use gritty cleaning compounds or very hot water to clean.

2. Adjustment

a. The 7064VP and 7084VP hand refractometer will need adjustment infrequently, if ever. In order to check adjustment, make sure the temperature of the instrument is between 70° and 80° F. For the 7064VP and 7084VP models take a reading on distilled water as explained above (the Brix reading should be 0 for distilled water).

3. MISCO PALM Abbe 202

a. Palm Abbe is a digital refractometer for measuring the freeze point of type I and the refractive index of Type IV.

b. The Palm Abbe can be customized by MICSO with various scales to fit the need of the end user. (Example, Celsius or Fahrenheit scales, EG or PG scales, Brix or Refractive Index scales).

Figure 6-4 Misco Palm Abbe 202

c. How to use the Palm Abbe

1. Push the menu button to turn on the Palm Abbe.
2. Using the Menu button select the scale needed.
3. Open the well lid
4. Using a soft clean dry towel clean the well and optic lens

Figure 6-5

5. Using distilled water, put a few drops into the well.
6. Close the lid to the well and push the “GO” button.
7. The display will show the measurement.

Figure 6-6

NOTE

Before each operation using distilled water, check the calibration of the refractometer. 0°C or 32°F to confirm the unit is measuring correctly. Document the date, operator's name, the refractometers identification number and that the unit is reading correctly.

8. Using a soft clean dry towel, dry the well and inspect making sure no water residue is left in the well of on the lens .

9. Add a few drops of deicing or anti-icing fluid to the well, close the well lid, push "GO" for a freeze point, Birx or RI reading.

Figure 6-7

NOTE

Refractometers require calibration certification every year before October 15th. This can be accomplished by sending the unit(s) to MICSO for calibration or qualified company to perform this required calibration.

6.2 Contract Deice Vendor Requirement

A. Procedure

1. Contract Deice Vendors that deice/anti-ice ABX Air aircraft are responsible to maintain refractometer(s) equivalent to the MISCO 7064VP and MISCO 7084VP or Palm Abbe Digital Refractometer for the purpose of determining the freeze point protection reading of the deice/anti-ice fluids used.

2. Contract Deice Vendors will maintain refractometer(s) in accordance with the ABX Deice Operations Manual, Chapter 6.

Chapter 7 - ABX Air Maintenance De-Ice Operations Procedures & Training Guidelines

[Ref. GRH 4.2.1]

A. REFERENCE DEICE OPERATION MANUAL CHAPTERS: General information, Definitions, Effects of icing on aircraft, Deice procedures, Deicing charts, Aircraft component location, Deice communication, Refractometer.

7.1 Outbased Deicing Procedures

A. ABX Flight Control Operations Officer will evaluate weather conditions, sequences, and forecasts at all stations of operation to determine the possible need for deicing and will inform Maintenance Control.

B. If deicing will be required at stations with ABX Air Deice Representatives or Qualified Deice Personnel:

1. Maintenance Control, will assist the Maintenance Representative, or Qualified Deice Personnel at the gateway.

2. Maintenance Representative or Qualified Deice Personnel will:

a. Confirm the deicing operators are Qualified Deice Personnel (see Chapter 8.)

b. Confirm the type, kind and mixture of the deicing fluid in use.

c. Perform a Post Deicing Check to ensure that the aircraft surfaces are clean after deicing the aircraft.

d. Note the time that the anti-ice application began.

e. Relay this information to the Flight Crew.

> NOTE
>
> **Current Hot Charts are available at**
> https://www.faa.gov; **Search: FAA Holdover Time Tables.**

C. If deicing is required at stations without ABX Air Maintenance Representatives or Qualified Deice Individuals:

1. Maintenance Control will assist Crew Member or OB using Deice Vendors Guide.

2. The Captain will be responsible for:

a. Determining the type, kind and mixture of the fluid. (Crew Deice Report)

b. Supervising the deicing/anti-icing application.

c. Ensure a Post Deicing Check is accomplished to determine the aircraft surfaces are “clean”. (Crew Deice Report)

d. Noting the time that the anti-ice application began. (Crew Deice Report)

D. Deice Operations with an ABX Air Maintenance Representative Deicing ABX Air Aircraft.

1. Upon receiving a "Deice Alert", the ABX Air Qualified Deice Maintenance Personnel are responsible to:

   a. Ensure the deice equipment is prepared and serviced.

   b. Ensure that the mixture of anti-icing fluid in the company equipment is checked for protection to at least 10°C degrees below ambient temperature as reported by ATIS or local weather observations. Use the "Refractometer" tester described in Chapter 6, to determine the freeze point of the anti-icing fluid.

   c. **Pre-Deicing**: The removal of snow and ice from an aircraft prior to departure sequence by Mechanical Methods or by the application of deice fluid as required.

   d. **Mechanical Method:** The removal of snow and ice from an aircraft using equipment such as a snow-broom, squeegee, rope or other approved economical method.

   e. Perform Pre-Deicing/Anti-icing as required throughout the day in an economical manner.

   f. Coordinate deicing needs with the Captain.

   g. Review any special provisions applicable to that specific airport.

   h. Coordinate the anticipated needs with the deice vendor. This is to include ensuring remote deice vendors are kept informed as to departure times, especially when changes to the scheduled departure time occur.

   i. Contact Maintenance Control if any deice equipment problems or environmental changes are encountered that could affect deice requirements.

   j. Oversee/Supervise Deice Vendor procedures when an ABX Air Deice/Anti-ice approved and trained vendor is unavailable.

2. Aircraft Storage

   a. Whenever possible, covers and plugs should be used. Before installation, apply deicing fluid to covers and plugs to prevent freezing to aircraft surfaces.

   b. Whenever parking aircraft, remove snow and ice as much as possible where tires are to be located to prevent the tires from freezing to the ramp.

   c. Whenever possible, always store the aircraft facing into the wind.

   d. All flight controls should be neutralized and flaps retracted during icing conditions to minimize ice accumulation.

3. Aircraft Movement and Taxi

   a. Movement of aircraft on ice and snow covered ramps can be difficult due to the lack of traction with tug equipment. Try to avoid using sand or other traction materials that may be ingested into aircraft engines. Avoid starting engines when ice, snow and debris present the possibility of ingestion and damage.

   b. At all times, towing and taxiing while the ground is iced over should be avoided.

c. Ensure that if the aircraft is to be taxied, all engine inlet covers are removed, the inlets are inspected for ice accumulations, and the N1 compressor sections are rotated by hand to ensure their freedom from ice. (Turbine Powered Aircraft).

d. Visually check the engine inlet for the accumulation of snow and remove any that may have blown into the intake.

e. Ensure the area ahead of inlets are free of ice, snow, and debris before engine starting.

4. Departure

a. Ensure that all engine plugs and protective covers are removed.

b. After deicing is completed, ensure that all drain holes are free and clear.

c. Inspect all engine inlets to ensure that they are free of ice accumulation and that the N1 compressor rotates freely.

d. Check all balance bays to ensure that drain holes are not plugged.

e. Ensure that all flight control surfaces are free and clear of ice, snow, and frost accumulation.

f. Ensure that the area in front of the cockpit windows are free and clear of snow and ice.

5. Avoid spraying deicing fluid mixtures on wheels, tires and brakes.If requested by the flight crew, aircraft maintenance will examine the wheel well area and advise the best means to deice this area as not to damage or remove the lubrication on these moving parts.

CAUTION

WHENEVER DEICING, DO NOT SPRAY GLYCOL ONTO STRUTS. IF THIS OCCURS, DRY THE STRUT AND COAT THE CHROME PORTION WITH A COATING OF MIL-5606 HYDRAULIC FLUID.

CAUTION

NEVER SPRAY FLUID ON HOT BRAKES

E. ABX Air Deice/Anti-ice Procedures Training Program [Ref. GRH 2.2.5]

The ABX Air Deice Operations and Training Designee is responsible for the Outbase Maintenance Personnel Deice/Anti-ice Training.

1. ABX Air Deice/Anti-ice Training is provided by the Maintenance Training Department for all Aircraft Maintenance Personnel assigned deicing duties.

2. The ABX Maintenance Training Supervisor or Designee is the point of contact for all Deice/Anti-ice Training material and records.

F. ABX Air Qualified Deice Personnel

Persons authorized by ABX Air, Inc. to perform the actual Deice/Antiice operation or to oversee the Deice/Anti-ice operation of ABX Air aircraft include:

1. Employees of ABX Air who have been trained in accordance with the procedures administrated by the ABX Air Deice/Anti-Ice Program.

2. Contract Deicing Vendors who have either been trained in accordance with the procedures administered by the ABX Air Deice/Anti-Ice Program or have similar Deice/Anti-Ice programs that have been submitted and accepted by ABX Air Maintenance Training. Additional details regarding Contract Vendor Deicing are in Chapter 8.

G. ABX Air Deice/Anti-ice Procedures Training Curriculum [Ref. GRH 2.2.5]

Employees of ABX Air as Qualified Deice Personnel that are expected to oversee deicing operations will receive Deice/Anti-Ice Procedures training.

1. ABX Air Qualified Deice Personnel and Deice Trainers will receive annual Deice/Anti-Ice Procedures training.

2. Annual Deice/Anti-Ice Procedures training will consist of a Computer Based Training (CBT) program covering the following:

   a. Effects of frost, ice, snow and slush on aircraft surfaces.

   b. Fluid types, characteristics, capabilities, restrictions and testing.

   c. Terms and Definitions.

   d. Holdover time chart use.

   e. Deicing and Anti-icing procedures.

   f. ABX Air aircraft sensitive surfaces.

   g. Communication procedures with Flight Crew and Crew Deice Report.

   h. Pre-Takeoff Check.

   i. Pre-Takeoff Contamination Check.

   j. An examination covering the procedures contained in the ABX Air Deice/Anti-ice Operations Manual.

   k. Annual training must be completed by all ABX Air Qualified Deice Personnel and Contract Deice Vendor Trainees before starting the next annual deice season.

H. ABX Air Qualified Deice/Anti-Ice Procedures Training Records

1. Deice/Anti-ice Procedures training records are held at KILN in the Loglevel CBT/LMS for all ABX Air Maintenance employees and Contract Deice Vendor employees who are “Qualified Deice Personnel”. Loglevel is an electronic record keeping system, approved under ABX Air's Ops Spec A025

2. Contract Deice Vendors will also maintain training records for completion of ABX Air Deice/Anti-Ice Procedures and deicing equipment training at their station.

Chapter 8 - CONTRACT DE-ICING & TRAINING

8.1 Contract De-icing Vendors

A. The Deice Operations Manager reports to the Director of Operation (119 FAA Position) and is responsible for:

1. Negotiating contract agreements with Contract Deice Vendors, where required.

2. Specifying which Contract Deicing Vendors will be sent ABX Air Deicing/Anti-icing Training Material.

3. Completing Deice Audit with each Deice Vendor at least once through the course of the deice season. (Guidance located in IAEP and SMS PRO.)

B. ABX Training Designee is responsible for:

1. Providing training material to the Contract Deicing Vendors and maintaining deice training records for the Qualified Deice Personnel.

2. Maintaining a list of specified Contract Deice Vendors who have completed ABX Air Deice training and providing that list to the Deicing Operations Manager should follow up be required.

3. Deice training records for Contract Deice Vendor’s will be maintained by the ABX Air Aircraft Maintenance Training Department. Records are made available to Vendors on abxtranet.com.

C. The ABX Air Publications Department will make available online the Deice/Anti-ice Operations Manuals and Training Material to all Contract Deice Vendors specified by the Deicing Operations Manager.

D. Contract Deice Vendors who are a 121 airline with an FAA approved Deice/Anti-Ice program are required to either complete the ABX Air Deice/Anti-Ice procedures training or are required to submit their similar FAA approved Deice/Anti-Ice program for ABX Air for review and acceptance. Contract Deice Vendors who are not a 121 airline, can submit their comprehensive de/anti-icing program to the ABX Air Deice Operations Manager for review. If the Contract Deice provider has a program that meets or exceeds the ABX Air FAA approved deice program, the Deice Operations Manager and the Director of Flight Operations can accept the Deice Providers program with differences and submit to the FAA for approval. If ABX Air accepts a 121 airline or a Contract Deice Vendor's program, ABX Air will send a letter of differences to the deice provider. The deice provider is required to train their deice operators the ABX differences and maintain a record of the differences training. Contract Deice Vendors who are not a 121 airline and their deice program was not approved by ABX Air must complete the ABX Air online Deice/Anti-Ice Procedures Training. An electronic version of the ABX Air Deice/Anti-Ice Operations Manual is available to the Contract Deice Vendor by invitation through the Deicing Training Designee. Each Contract Deice Vendor is responsible for assuring training of employees on ABX Aircraft has been accomplished. The Vendor is encouraged to utilize ABX Air’s online training material for all of their employees if they have the resources. After completing the ABX Air online Deice test, the results will be recorded in the ABX Air deicing training record. Records of Contract Vendor Employees that have completed training will be provided to the Contract Deicing Vendor. The employee training records will be maintained at the Contract Deice Vendor’s station. Contract Deice Vendors who do not complete the ABX Air Deice/Anti-Ice Training will require oversight during deicing/anti-icing of ABX Air aircraft by ABX Air Qualified Deice personnel. The Pilot In Command and ABX Line Maintenance Representatives are ABX Air Qualified Deice Personnel.

E. Deice Vendor Equipment Training

ABX Air does not own any deice equipment for deicing aircraft, ADF storage or ADF testing. Each deice vendor is required to train their employees on the deice equipment they own by a qualified trainer such as the OEM or someone currently qualified with in the contract vendor's company. The contract vendor will maintain training records for all equipment training and have these records available to ABX Air up on request.

NOTE

Deice providers are required to maintain all deice equipment and products in accordance to manufacturers guidelines and maintain records.

F. Deice Operations Without an ABX Air Maintenance Representative

At stations without an ABX Air Maintenance Representative, the Captain is responsible to coordinate the deicing needs with the deice provider upon arrival at that station. The Captain will coordinate and oversee the deice process and any special requirements for that airport. He will cover the following with the Deice Personnel:

1. Review critical surfaces with the deice provider.
2. Review required inspections (Post Deice Check).
3. Review the required "Crew Deice Report" with the deice provider.

G. Deice Operations Without an ABX Air Qualified Deice Provider

At stations without an ABX Air Qualified Deice Provider, the Captain or otherwise ABX Air Qualified Deicing/Anti-Icing Personnel is responsible to coordinate the deicing/anti-icing needs with the company selected local deice provider upon arrival at that Station. The Captain or ABX Air Qualified Deice/Anti-Ice Personnel will coordinate and oversee the deice/anti-ice process and ensure any special requirements are met for that airport.

H. Deice Operations With an ABX Air Qualified Deice Provider and ABX Air Maintenance Representative. At stations where there is an ABX Air Qualified Deice Provider and ABX Air Maintenance Representatives, the ABX Air Maintenance Representatives will confirm prior to the start of deicing/anti-icing operations that the Deice Provider/Operators are qualified ABX Air Qualified Deicing Personnel. If Deicing Provider/Operator cannot demonstrate that they are ABX Air Qualified Deicing Personnel, ABX Air Maintenance Representatives that are ABX Air Qualified Deicing Personnel will provide oversight during the deicing/anti-icing of ABX Air aircraft.

I. With any questions in regards to ABX deice, please contact ABX Maintenance (abxmc@abxair.com) or Kent Stewart (Kent.stewart@lgstx.com) at ABX Air Deice.

8.2 DEICE/ANTI-ICE Procedures Training Program

8.2.1 General

A. Applicability: The ABX Air, Inc. FAA approved Deice/Anti-ice Operations Training program will be given to:

1. Outbase Maintenance Representatives.
2. Maintenance and Ground Personnel who perform Deicing/Anti-Icing Duties.
3. Contract Deicing Agencies.

B. Course Length: As outlined

C. Course Objective: To train the respective personnel in the portions of the ABX Air, Inc. FAA approved Deice/Anti-Ice Program that apply to their function in the program.

D. Training Aids:

1. Federal Aviation Regulations.
2. Computer Generated Images
3. Computer-based Training Module Titled: B767 De-Ice Anti-Ice Procedures Training located in Loglevel.

E. References

a. 14 CFR 121.629

b. Advisory Circular (AC) 20-117 (as amended)

c. Advisory Circular (AC) 120-58 (as amended)

d. Advisory Circular (AC) 120-60 (as amended)

e. Advisory Circular (AC) 150/5200-30 (as amended)

f. Operational Specifications A023

g. Deice/Anti-Ice Operations Manual (DAOM).

h. Deicing Trucks - for outbase maintenance representatives and ground personnel.

F. Course Outline Follows:

Table 8-2 ABX Air, Inc. Deice/Anti-Ice Procedures Training Syllabus

		Programmed Hours
		Initial
1.	Introduction	.1
2.	Safety Management System Overview	.1
3.	Safety Reporting	.1
4.	DEICE ANTI-ICE OPERATIONS MANUAL Location	.1
5.	Course Objectives	.1
6.	Review of 14 CFR 121.629	.1
7.	Review of Previous Deice Related Aircraft Accidents	.1
8.	Effects of Frost, Ice, Snow & Slush	.1
9.	Lift vs. Drag	.1
10.	Airframe & Engine Icing Review	.1

		Programmed Hours
		Initial
11.	Types of Contaminants	.1
12.	Definitions	.1
13.	General Deicing/Anti-icing Procedures	.1
14.	Deicing Fluids	.1
15.	Validation of Deice Truck Temperatures 140 °F	.1
16.	Ant-icing Type II, II & IV fluids	.1
17.	Fluid Application Procedures	.1
18.	Post Deicing Checks	.1
19.	Deice Truck Movement & Positioning	.1
20.	No Direct Spray Areas	.1
21.	Critical Aircraft Surface Review	.1
22.	Crew Deicing Report	.1
23.	Freeze Point Depressant Fluid Discussion	.1
24.	Refractometer Calibration	.1
25.	Fluid Mix vs OAT	.1
26.	Holdover Charts	.1
27.	Roles & Responsibilities of Deice Personnel	.1
28..	Review and Test	.1
	TOTAL PROGRAMMED HOURS	2.2

8.2.2 Deice/Anti-Ice Training for Outbased Maint. Reps, ABX Deice Personnel and Contract Deice Providers

Table 18-1. ABX Air, Inc. Deice/anti-ice Training Program for Outbased Maintenance Representatives, ABX Deice Personnel and Contract Deice Providers

		ABX Air CBT/LMS	OJT Hours
1.	Deice Program Background	ABX Air CBT/LMS	N/A
2.	Organizational Responsibilities	ABX Air CBT/LMS	N/A
3.	Definitions and Terms	ABX Air CBT/LMS	N/A
4.	Holdover Times	ABX Air CBT/LMS	N/A
5.	Effect of Frozen Contamination on Aircraft Surfaces	ABX Air CBT/LMS	N/A

		ABX Air CBT/LMS	OJT Hours
6.	Aircraft Deice/Anti-Icing Procedures	ABX Air CBT/LMS	N/A
7.	Glycol Characteristics	ABX Air CBT/LMS	N/A
8.	Deice Operations	ABX Air CBT/LMS	N/A
9.	Quality Assurance	ABX Air CBT/LMS	N/A
10.	Personal Protective Equipment (PPE) (If Applicable)	N/A	0.2
11.	On the Job Training (OJT) (If Applicable)	N/A	1.0
12.	Specific Deice Truck Operations (If Applicable)	N/A	1.0
	Total Hours	2.0	2.2

NOTE

All ABX Air Qualified De/Anti-Ice Personnel, Company Employee and Contract Deice provider are required to complete the 2 Hour CBT/LMS.

NOTE

ABX Air can accept other 121 carrier's Deice program in lieu to completing the ABX Air Deice training CBT/LMS. Accepting other 121 programs will be approved by the Director of Operations at ABX Air.

NOTE

If the Deice operator has not completed the ABX Air Deice training, a qualified ABX Air Deice Representative or Pilot in Command will need to oversee the deice process.

8.2.3 Training Outline

1. Deice Program Background

   Examples of Icing Related Accidents

2. Organizational Responsibilities

   A. Vice President of Flight Operations

   B. Director, Flight Operations

   C. Manager, Flight Standards & Training

   D. Supervisor, Flight Operations Technical Programs

   E. Director, Line Maintenance

   F. Flight Operations Officer Shift Supervisor

   G. Manager of ABX Air Deice Operations

H. Pilot In Command

3. Definitions and Terms Used Within the Program

A. Holdover Times

B. Holdover Chart

C. Deicing

D. Anti-lcing

E. Type I Fluids

F. Type II Fluids

G. Type III Fluids

H. Type IV Fluids

I. Types of Surface Contamination

J. Representative Aircraft Surfaces

K. Post Deicing Check

L. Pre-Takeoff Check

M. Tactile Inspection

N. Pre-Takeoff Contamination Check

4. Effects of Frozen Contaminants on Aircraft Performance

A. Critical Aircraft Surfaces

B. Aircraft Stability

C. Aircraft Control

5. Personal Protective Equipment (PPE)

A. Open Bucket Truck

B. Enclosed Bucket Truck

C. Rain suit With Hood

D. Protective Waterproof Gloves

E. Eye Protection (Face Shield, Goggles, etc...)

F. Safety Harness and Lanyard

G. Seat Belt

H. Communication Equipment

6. Aircraft Deicing/Anti-icing Procedures
    A. B767 Deicing Areas

        Specific Deice Targets

        1. Fuselage
        2. Tail
        3. Wing
        4. Other Areas (if requested)

    B. Post Deicing Check
    C. Communication Procedures With Flight Crew
    D. Crew Deice Report (Written/Verbal)
    E. Pre-Takeoff Check
    F. Pre-Takeoff Contamination Check
7. Glycol Characteristics
    A. Glycol Testing
    B. Lowest Operational Use Temperature (LOUT)
    C. Holdover Charts--Type I, Type II, Type III, and Type IV
8. Outbased Operations For Outbased Maintenance Personnel/Contract Vendors
9. On-The-Job-Training
    A. Hands-on Practice With Deice Truck
    B. Hands-on Practice Spraying Aircraft
10. Quality Assurance
    A. Testing For Maintenance Personnel
    B. Testing For ABX Deice Personnel
    C. Testing For Contracted Vendors