

**LJUBLJANA AIRPORT  
AIRCRAFT DE-ICING PLAN  
Winter Season 2021/2022**



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## 1 INTRODUCTION

This document describes materials, equipment and operational procedures for de-icing/anti-icing of aircraft on the ground at **Ljubljana Airport** during the official winter season – **from October 15<sup>th</sup> to April 15<sup>th</sup>, of the following year**. The de-icing and anti-icing procedures were established according to the recommendations made by ICAO Recommendations, EASA and the SAE Global De-icing Standards and are intended to ensure safe, timely and efficient removal of ice, snow, slush and other deposits from aircraft surfaces.

The basic intention of this document is not to substitute the procedures laid down in AIP - Aeronautical Information Publications, but to offer additional information to the operating staff of various airlines so as to ensure that all aircraft de-icing/anti-icing procedures are carried out properly and safely.

This plan will be reviewed annually and published before the start of the new winter season.

This edition of the **Aircraft De-icing Plan** is based on the:

- ICAO Doc 9640-AN/940, Manual of Aircraft Ground De-icing/Anti-icing Operations,
- SAE AS6285 Standard – Aircraft Ground De-icing/Anti-icing Processes,
- SAE AMS1424 Standard – De-icing/Anti-icing Fluid, Aircraft SAE Type I,
- SAE AMS1428 Standard – Fluid, Aircraft De-icing/Anti-icing, Non-Newtonian (Pseudoplastic), SAE Types II, III and IV,
- FAA, Holdover Time (HOT) Guidelines, Winter 2021-2022, Original Issue August 4, 2021,
- Fraport Slovenia d.o.o., Navodilo za razleditev/protileditev letal (De-icing/Anti-icing Manual); *DAM-WS 2021-2022*.

## 2 GENERAL INFORMATION

### 2.1 Contacts

De-icing/Anti-icing provider	FRAPORT SLOVENIJA d.o.o. Zgornji Brnik 130A SI-4210 Brnik-aerodrom <a href="http://www.fraport-slovenija.si">http://www.fraport-slovenija.si</a>
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Matej Kalar Ramp Ground Handling Manager	T: +386 4 2061 948 E-mail: <a href="mailto:matej.kalar@fraport-slovenija.si">matej.kalar@fraport-slovenija.si</a>
Ground Handling De-icing Coordinator	Tel.: +386 4 2061 214 E-mail: <a href="mailto:loadcontrol@fraport-slovenija.si">loadcontrol@fraport-slovenija.si</a> VHF Radio Frequency: 131,405 MHz

## 2.2 De-icing/Anti-icing Vehicles

The following vehicles are used for de-icing/anti-icing procedures:

- DE-ICER No. 1, DE-ICER No. 2 and DE-ICER No. 5: Vestergaard, Elephant Beta. Hot water in the first tank and ADF Type I in the second tank. Mixture is prepared by proportional mixing system. Cold undiluted (100%) Type IV fluid in the third tank.
- DE-ICER No. 4: Vestergaard, Elephant Gamma. Type I pre-mix (ADF type I/water) in the first heated tank and undiluted (100%) Type IV fluid in the second tank.



## 2.3 De-icing/Anti-icing Fluids

At Ljubljana Airport the following de-icing/anti-icing fluids are used:

- **ADF SAE Type I:** Kilfrost, DF Plus  
Clariant, Safewing MP I 1938 ECO (80)  
Clariant, Safewing MP I LFD 80
- **ADF SAE Type IV:** Kilfrost, ABC-S Plus  
Clariant, Safewing MP IV LAUNCH

## 2.4 Description of Terms and Abbreviations

In the process of removing snow, ice and other deposits from the aircraft and in performing anti-icing activities we come across the following terms and expressions:

- De-icing

De-icing is a procedure of removing ice, snow, slush and freezing rain from the surface of the aircraft by using special fluids and equipment.

- Anti-icing

Anti-icing is a procedure of protecting clean aerodynamic surfaces of the aircraft with the aim to prevent ice and snow deposits to reappear on these surfaces until the moment the aircraft takes-off.

- Hold-Over Time

Hold-Over Time is a time-limited period during which the anti-icing fluid is supposed to prevent ice, snow or slush to appear again on the surface of the aircraft in the given weather conditions. The Hold-Over Time starts at the beginning of the last step of one or two-step procedure.

- Aircraft De-icing/Anti-icing Fluid

Aircraft De-icing/Anti-icing Fluid – ADF – is a fluid which is used, pure or mixed in a solution with hot water, for de-icing/anti-icing procedure.

- Post De-icing/Anti-icing check

A verification of clean surfaces, final clearance after de-icing/anti-icing by a trained and qualified person. This check can be either visual or tactile and shall cover wings, horizontal and vertical stabilizers, fuselage and other parts of the aeroplane on which the de-icing/anti-icing treatment was performed.

- Anti-icing code

Anti-icing code is final information to the flight crew referring to the last step of the procedure. It contains least the following:

- The fluid type (e.g. Type I or type IV),
- The fluid name (manufacturer and brand name) of the type IV, if applicable,
- The concentration of fluid within the fluid/water mixture, expressed as a percentage by volume.
- Start of the final treatment or start of the second step at two-step procedure (local time),
- The confirmation that the Post de-icing/anti-icing check is completed and
- The confirmation that the de-icing vehicles are removed from the de-icing position.

## 3 DE-ICING/ANTI-ICING PROCEDURES

### 3.1 The Impact of Winter Conditions on Airside Operations

Snow and ice on the airport are usually the reasons for the occurrence of bottlenecks in ground handling of aircraft. These problems are mainly caused by the following factors:

- Limited number of staff, vehicles and de-icing/anti-icing equipment;
- Limited capacities needed for cleaning the apron, manoeuvring areas and runways;
- Constant changes of weather conditions at the airport;
- Delays and cancellations of flights on other lines; and
- Unfavourable working conditions.

To prevent or reduce delays in air-traffic during the winter season it is extremely important to start and finish all preliminary operations related to ground handling of aircraft, passengers and cargo in due time. It means that the anticipated time needed for de-icing/anti-icing of aircraft, not necessary in normal weather conditions, must be taken into account.

### 3.2 General Conditions for De-icing/Anti-icing

The decision as to whether or not an aircraft needs to be de-iced is taken by its pilot in command (CMDR).

Fraport Slovenia is in charge of carrying out the aircraft de-icing/anti-icing procedures and the post de-icing/anti-icing check.

The de-icing/anti-icing of any given aircraft shall be decided upon in coordination between the pilot in command (CMDR) and De-icing Coordinator of Fraport Slovenia. The CMDR will communicate his request regarding procedure to be used and applicable ADF mixture ratios. De-icing Coordinator will recommend a de-icing/anti-icing procedure and fluid concentration for aircraft de-icing according to the weather situation and outside air temperature.

Normally the aircraft de-icing/anti-icing procedures are carried out at the de-icing pad DE-1 and on Taxiway N on the apron. In some particular circumstances the de-icing/anti-icing procedures may also be performed on aircraft parking position, on Taxiway M or just before take-off on the Runway. De-icing/anti-icing at the access point to the runway is only carried out exceptionally upon express approval of the Ljubljana Tower.

De-icing/anti-icing of propeller driven aircraft (except ATR 42/72) are performed on parking position on apron for safety reasons.

Outside of the annual de-icing season (Apr. 16<sup>th</sup> – May 31<sup>st</sup> and Oct. 1<sup>st</sup> – Oct. 14<sup>th</sup>) Fraport Slovenia will have at least one de-icing/anti-icing vehicle on standby in case of unexpected requests.

### 3.3 Basic Principles

The request for de-icing/anti-icing of an aircraft is made by the responsible pilot.

The Fraport Slovenia as a de-icing/anti-icing provider, is responsible for accomplishing the de-icing/anti-icing of aircraft, verifying the results of the de-icing/anti-icing treatment and for the information reported to the flight deck crew.



### 3.3.1 One Step De-icing

In case of frost conditions. It is performed with hot Type I mixture with a freezing point of at least 10 °C below OAT.

Normally are used:

- 40% Type I fluid / 60% water at temperature above – 5 °C;
- 60% Type I fluid / 40% water at temperature below – 5 °C;

### 3.3.2 Two Step De-icing

In case of freezing fog, snow, freezing drizzle, or light freezing rain conditions. Normally are used:

- First step with hot Type I mixture with a freezing point of at outside air temperature (OAT) or below (15%, 25% or 40% mixture).
- Second step with undiluted (100%) cold Type IV fluid.

### 3.4 Setting Priorities for Aircraft De-icing/Anti-Icing

Normally the time table of the flights will be considered first. In case the several aircraft departures are foreseen in a short period of time the Airport Traffic Coordination Centre in collaboration with ATC (Tower) is responsible for determining the priority order for de-icing/anti-icing.

Below stated flights shall be treated with a higher priority:

- Ambulance flights when a medical emergency is given,
- Flights transporting LHO (Living Human Organs),
- Government flights,
- Departure flights with a critical crew duty time limitation – if at all possible be given priority. It is the aircraft operators responsibility at the earliest possible time to inform what the latest airborne time is, to which the flight can be carried out.

### 3.5 De-icing/Anti-icing Notification

The de-icing/anti-icing order can be notified by the CMDR or any other authorised person to the De-icing Coordinator (Turnaround Coordinator) on frequency 131.405 MHz or directly on the apron at least 15 minutes before off-block time.

**De/Anti-icing notification must contain the flight number, aircraft type and parts of the aircraft which shall be de-iced/anti-iced (e.g. wings, fuselage, stabilizers, landing gear, etc.).**

**The CMDR must expressly order any non-standard de-icing such as underwings de-icing, manual removal of snow from the particular surfaces of the aircraft, and de-icing of landing gear or engine fan blades de-icing with the hot-air.**

De-icing notification:	<ul style="list-style-type: none"> <li>– To Turnaround Coordinator on main apron</li> <li>– VHF: 131,405 MHz or phone: + 386 4 2061 214*;</li> </ul>
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\* Telephone requests shall only be made in exceptional cases, i.e. crew not yet present at the aircraft.



After receiving the notification for de-icing/anti-icing the Turnaround Coordinator informs to the crew with the disposable de-icing/anti-icing parameters. At the same time the CMDR shall be informed when the aircraft will be de-iced and also where the de-icing will take place, i.e. the parking position, at the de-icing pad DE-1, on TWY N or TWY M.

*Example of information:* De-icing will be performed at the de-icing pad DE-1, expect follow-me for repositioning at 07:50.

### 3.6 De-icing/Anti-icing on Parking Position

At individual parking position on apron the de-icing/anti-icing of propeller driven aircraft (except ATR 42/72) is carried out. The hot air de-icing (engine fan blades, landing gear) and manual removal of snow from aircraft surfaces will be carried out at parking position as well.

Parking position could be used also when remote de-icing pad DE-1 is not in function, for de-icing of fuselage with type I in heavy snow condition and for de-icing for bigger aircrafts such as AN-124, B-747, A-300 etc.

Before the de-icing/anti-icing procedure begins, the engines of the aircraft must be turned off, breaks applied and air-conditioning openings and the APU, if switched off, must be closed. All passenger doors and cargo areas must also be closed and all ground handling equipment removed from the parking position. Exceptionally the GPU could remain connected during the de-icing treatment.

### 3.7 De-icing/Anti-icing on Remote Position

De-icing of jet aircraft up to category C, exceptionally category D and ATR 42/72 with operative propeller braking, normally takes place on the de-icing pad DE-1. It is located in the south-eastern part of the main apron and can be accessed through the TWY E1.

In some cases the de-icing of jet aircraft will take place on TWY N or TWY M.

Before the de-icing/anti-icing procedure, the aircraft is transferred from the parking position to the de-icing position upon prior authorisation of the Ljubljana Tower (start-up clearance) and in some cases after push-back by means of its own engines and guided by a follow-me vehicle. In case the pad DE-1 is temporary occupied, the follow-me vehicle will hold the aircraft on TWY E1 until the pad DE-1 is free.

The aircraft may be transferred to the de-icing position after all the operations related to handling of passengers and cargo have been finished and when the doors and other openings of the aircraft have been closed. Afterwards, no ground handling device may approach.

**Due to jet blast exposure to the de-icing vehicles and teams only minimum engine power shall be used for aircraft movements onto and off the de-icing pads. APU shall be switched off\*.**

*\*For aircraft of the CRJ type: If the fuselage is not sprayed, the APU may be switched on.*

In order to maintain visual STOP communication on all remote de-icing positions, follow me vehicle stays in front of the aircraft until de-icing is finished and all vehicles removed.

### 3.8 De-icing/Anti-icing on Manoeuvring Areas

In case the de-icing procedure is performed on the runway due to exceptionally unfavourable weather conditions, the process of ordering de-icing/anti-icing and the procedure itself are carried out under the same conditions which also apply in case of de-icing at the de-icing pad DE-1. During the procedure the engines of propeller driven aircraft must be switched off.

**All participants must maintain constant radio connection with ATC (Ljubljana Tower)!**

### 3.9 De-icing/Anti-icing of General Aviation Aircraft

General aviation jet aircraft can normally be de-iced/anti-iced on the de-icing pad DE-1 or on TWY N with running engines, according to the procedure for jet aircraft on main apron.

When parked at General Aviation apron, and by agreement with Turnaround Coordinator, the aircraft can also be de-iced at parking position with engines switched off. Prior to de-icing, the pilot shall verify on ATC frequency (Ljubljana Tower) that there is no departure delay. After completing de-icing/anti-icing, pilot shall immediately request start-up clearance. At that time, the remaining hold-over time shall also be reported.

### 3.10 Communication

Communication between the cockpit crew and the ground staff (de-icing team) on the remote de-icing position or on parking stand is carried out via VHF frequency. The following radio frequency are used on the individual de-icing position:

De-icing notification / place of de-icing	Call sign	Frequency
De-icing notification (De-icing Coordinator)	"Ljubljana De-icing"	131,405 MHz
De-icing on pad DE-1	"De-icing pad 1"	131,705 MHz
De-icing on TWY N	"De-icing pad N"	131,755 MHz
De-icing on TWY M	"De-icing pad M"	
De-icing on parking stand	"De-icing Ramp"	

#### Notes:

- Up to two de-icing positions with two different frequencies may operate at the same time during de-icing operations.
- Regardless of the position on which the de-icing/anti-icing procedure will take place, the crew must maintain constant radio connection with the De-icing team on one of the determined frequencies 131.705 MHz or 131.755 MHz.
- The CMDR shall inform the De-icing team leader via radio frequency when the aircraft is prepared for de-icing.
- During de-icing/anti-icing operations on remote de-icing position, with aircraft engines running, both verbal (VHF) and visual (vehicle or. traffic lights) stop communication are utilized.
- When the de-icing procedure is over and post de-icing/anti-icing check is completed, the De-icing team leader informs the CMDR that the surfaces of the aircraft are free of ice, snow, slush or other deposits. He submits so-called "*Anti-icing code*", i.e. ADF type, ratio ADF/water and the beginning of Hold-over time. At the same time he also confirms that all vehicles have been removed from the aircraft. On special request, the De-icing team leader will also report the consumption of the de-icing fluids and the brand name of used fluid. No other documents about de-icing treatment are provided at that time.

### 3.11 Recording and Controlling of the De-icing/Anti-icing

Post de-icing/anti-icing check is performed by the de-icing team normally from de-icing vehicle. This check visually covers all critical parts of the aircraft.

At the remote de-icing positions (DE-1, TWY-N or TWY-M), as a rule, no special control inspections, such as tactile check are carried out. If nevertheless a tactile check is requested by cockpit crew or de-icing operator considered that tactile check is needed, CMDR may be requested to switch off engines temporarily. Permission to restart engines does not need to be obtained from Ljubljana Tower again.

### 3.12 Special Icing Conditions and De-icing Requirements

- Clear-ice conditions on wings shall be reported to the de-icing coordinator with the de-icing notification.
- The aircraft operator must be aware that fan blade de-icing is not an integral part of the standard aircraft de-icing/anti-icing process. Fan blade de-icing must be requested separately and cannot be performed on a remote de-icing pad. The aircraft operator must take into consideration the duration of the process and shall revise the take-off block time (TOBT) accordingly. Aircraft de-icing/anti-icing shall be carried out after fan blade de-icing is completed.
- Underwing, belly and landing gear de-icing can only be performed on apron parking stand upon request by carrier's staff, with engines off.
- De-icing/anti-icing of the smaller propeller aircraft, which require GPU to be connected, can be performed at first on the opposite side of the connected GPU. After switching on the first engine and disconnecting the GPU, the de-icing/anti-icing on the other side of the aircraft can be performed.
- In case of some general aviation aircraft and certain individual airlines, the invoice for ground handling of the aircraft must be issued and settled before the take-off. In such cases the De-icing team leader shall estimate, upon the order, the quantity of the de-icing/anti-icing fluid applied and enter it into the De/Anti-Icing Data System.
- An engine run up above idle, on the de-icing area, after the completion of the de-icing/anti-icing treatment, is strictly prohibited. Engine run up is allowed later, during taxiing on TWY A.

## 4 ATTACHMENTS

### 4.1 A Sample of Communication Procedure for De-icing/Anti-icing of Aircraft on Remote De-icing Position

**DTL** – De-icing Team Leader

**DC** – De-icing Coordinator (Turnaround Coordinator)

**TWR** – Ljubljana Tower

**CMDR** – Commander (Pilot in command)

When	Who	To whom	What
De-icing notification	CMDR	DC	LJUBLJANA DE-ICING [Call Sign], REQUEST DE-ICING. Specify which parts of the aircraft shall be de-iced. (e.g. wings, underwings, fuselage, stabilizers, landing gear, etc.)
Upon receiving the order	DC	CMDR	[Call Sign], DE-ICING ORDER IS ACCEPTED. Acquaint with available parameters of the D/A procedure. If not agreed yet: EXPECT FURTHER INFORMATION - TIME AND POSITION OF THE DE-ICING SHORTLY.
When arriving to the aircraft	DC	CMDR	YOU WILL BE PREPARED FOR REPOSITIONING TO THE DE-ICING PAD AT [hh:mm]
When all ground handling activities are finished	CMDR	TWR	LJUBLJANA TOWER, [Call Sign], REQUEST START-UP FOR REPOSITIONING TO THE DE-ICING PAD.
	TWR	CMDR	[Call Sign], START-UP APPROVED.
When the de-icing pad is free			Aircraft is leaded to the de-icing pad by follow-me vehicle. During de-icing it stays in front of the aircraft and maintain visual STOP communication.
When the aircraft is parked at the pad DE-1 (TWY N, M)	DTL	CMDR	[Call Sign], LJUBLJANA DE-ICING 1 (N, M), PLEASE, CONFIRM PARKING BRAKE IS SET AND AIRCRAFT READY FOR DE-ICING.
When the aircraft is ready for de-icing	CMDR	DTL	[Call Sign], PARKING BRAKE IS SET AND AIRCRAFT IS READY FOR DE-ICING.
After confirmation that aircraft is ready for de-icing	DTL	CMDR	[Call Sign], WE WILL USE TYPE I, 40% OR WE WILL USE TYPE I 25% FOR DE-ICING AND TYPE IV 100% FOR ANTI-ICING. .... WE BEGIN TREATMENT NOW, I WILL CALL YOU BACK WHEN READY.
When the de/anti-icing procedure is completed	DTL	CMDR	[Call Sign], AIRCRAFT DE-ICED (ANTI-ICED) WITH TYPE I (IV), NAME OF THE FLUID, [XX] %, START OF THE FINAL TREATMENT (or START OF THE SECOND STEP) AT [hh:mm] LOCAL. POST DE-ICING/ANTI-ICING CHECK COMPLETED, ALL VEHICLES REMOVED. (Plus any additional info on request such as brand name of fluid, fluid consumption, date ...), CONTACT TOWER FOR FURTHER TAXI.
Before taxiing to the manoeuvring area	CMDR	TWR	LJUBLJANA TOWER, [Call Sign] DE-ICING PAD-1 (N, M), REQUEST TAXI. <i>If in a hurry:</i> FOR YOUR INFORMATION, HOLD OVER TIME REMAINING [xx] MINUTES.
	TWR	CMDR	[Call Sign], TAXI TO [Instructions].

During de-icing/anti-icing process, the register or "tail number" of the aircraft instead of flight number could be used during all communications between the pilot and the de-icing team.

## 4.2 Active Frost Holdover Times for SAE Type I and Type IV Fluids

Guidelines for holdover times anticipated for Type I and Type IV fluid mixtures in Active Frost Conditions as a function of OAT.

Note: Type II and Type III fluids are not in use at LJU Airport.

Outside Air temperature (OAT) <sup>1,2,3</sup>	Holdover Time (h:min)	Outside Air temperature (OAT) <sup>2,3</sup>	Concentration Fluid/Water By % Volume	Holdover Time (h:min)		
	Type I			Type II	Type III <sup>4</sup>	Type IV
-1 °C and above	0:45 (0:35) <sup>5</sup>	-1 °C and above	100/0	8:00	2:00	12:00
			75/25	5:00	1:00	5:00
			50/50	2:00	0:30	3:00
Below -1 to -3 °C		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		100/0	8:00	2:00	10:00	
			75/25	4:00	1:00	5:00
Below -10 to -14 °C		100/0	6:00	2:00	6:00	
			75/25	1:00	1:00	1:00
Below -14 to -21 °C	100/0	3:00	2:00	6:00		
Below -21 to -25 °C		2:00	2:00	4:00		
Below -25 °C to LOU		Below -25 °C	100/0	No Holdover Time Guidelines Exist		

Reference: FAA Holdover Time Guidelines, Winter 2021-2022, Table 1

### NOTES

- 1 Type I Fluid/Water mixture must be selected so that the freezing point of the mixture is at least 10 °C below the actual outside air temperature (OAT).
- 2 Ensure that the lowest operational use temperature (LOU) 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 take-off.
- 4 To use the Type III fluid frost holdover times, the fluid brand being used must be known. AllClear Aero Clear 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 pre-take-off check procedures.

### 4.3 Holdover Times for SAE Type I Fluid on Critical Aircraft Surfaces Composed Predominantly of Aluminium

Guidelines for holdover times anticipated for Type I fluid mixtures as a function of weather conditions and OAT.

Outside Air Temperature <sup>1,2</sup>	Freezing Fog, Freezing Mist <sup>3</sup> or Ice Crystals	Very light snow, Snow grains or Snow Pellets <sup>4,5</sup>	Light Snow, Snow grains or Snow Pellets <sup>4,5</sup>	Moderate Snow, Snow grains or Snow Pellets <sup>4</sup>	Freezing Drizzle <sup>6</sup>	Light Freezing Rain	Rain on Cold Soaked Wing <sup>7</sup>	Other <sup>8</sup>
-3 °C 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	
Below -3 to -6 °C	0:08-0:13	0:14-0:17	0:08-0:14	0:05-0:08	0:05-0:09	0:02-0:05	CAUTION No holdover time guidelines exist	
Below -6 to -10 °C	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	0:05-0:09	0:07-0:08	0:04-0:07	0:02-0:04				

Reference: FAA Holdover Time Guidelines, Winter 2021-2022, Table 2

#### NOTES

- 1 Type I fluid/water mixture must be selected so that the freezing point of the mixture is at least 10 °C below outside air temperature (OAT).
- 2 Ensure that the lowest operational use temperature (LOUT) is respected.
- 3 Freezing mist is best confirmed by observation. It is never reported by METAR however it can occur when mist is present at 0 °C and below.
- 4 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (FAA-Table 43) is required.
- 5 Use Light Freezing Rain holdover times in conditions of very light or light snow, mixed with light rain.
- 6 Includes light, moderate and heavy freezing drizzle. Use Light Freezing Rain holdover times if positive identification of Freezing Drizzle is not possible.
- 7 No holdover time guidelines exist for this condition for 0 °C and below.
- 8 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 the 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 pre-take-off check procedures.

## 4.4 Holdover Times for SAE Type I Fluid on Critical Aircraft Surfaces Composed Predominantly of Composites

Guidelines for holdover times anticipated for Type I fluid mixtures as a function of weather conditions and OAT.

Outside Air Temperature <sup>1,2</sup>	Freezing Fog, Freezing Mist <sup>3</sup> or Ice Crystals	Very light snow, Snow grains or Snow Pellets <sup>4,5</sup>	Light Snow, Snow grains or Snow Pellets <sup>4,5</sup>	Moderate Snow, Snow grains or Snow Pellets <sup>4</sup>	Freezing Drizzle <sup>6</sup>	Light Freezing Rain	Rain on Cold Soaked Wing <sup>7</sup>	Other <sup>8</sup>
-3 °C and above	0:09-0:16	0:12-0:15	0:06-0:12	0:03-0:06	0:08-0:13	0:02-0:05	0:01-0:05	
Below -3 to -6 °C	0:06-0:08	0:11-0:13	0:05-0:11	0:02-0:05	0:05-0:09	0:02-0:05	CAUTION No holdover time guidelines exist	
Below -6 to -10 °C	0:04-0:08	0:09-0:12	0:05-0:09	0:02-0:05	0:04-0:07	0:02-0:05		
Below -10 °C	0:04-0:07	0:07-0:08	0:04-0:07	0:02-0:04				

Reference: FAA Holdover Time Guidelines, Winter 2021-2022, Table 3

### NOTES

- 1 Type I fluid/water mixture must be selected so that the freezing point of the mixture is at least 10°C below outside air temperature (OAT).
- 2 Ensure that the lowest operational use temperature (LOUT) is respected.
- 3 Freezing mist is best confirmed by observation. It is never reported by METAR however it can occur when mist is present at 0 °C and below.
- 4 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (FAA-Table 43) is required.
- 5 Use Light Freezing Rain holdover times in conditions of very light or light snow, mixed with light rain.
- 6 Includes light, moderate and heavy freezing drizzle. Use Light Freezing Rain holdover times if positive identification of Freezing Drizzle is not possible.
- 7 No holdover time guidelines exist for this condition for 0 °C and below.
- 8 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 the 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 pre-take-off check procedures.



### 4.5 Generic Holdover Times for SAE Type IV Fluids

Guidelines for holdover times anticipated for Type IV fluid mixtures as a function of weather conditions and OAT.

Outside Air Temperature <sup>1</sup>	Fluid Concentration Fluid/Water By % Volume	Freezing Fog, Freezing Mist <sup>2</sup> , or Ice Crystals	Very Light Snow, Snow Grains or Snow Pellets <sup>3,4</sup>	Light Snow, Snow Grains or Snow Pellets <sup>3,4</sup>	Moderate Snow, Snow Grains or Snow Pellets <sup>3</sup>	Freezing Drizzle <sup>5</sup>	Light Freezing Rain	Rain on Cold-Soaked Wing <sup>6</sup>	Other <sup>7</sup>
-3 °C and above (27 °F and above)	100/0	1:15 - 2:40	1:55 - 2:20	1:00 - 1:55	0:30 - 1:00	0:40 - 1:10	0:20 - 0:35	0:08 - 1:05	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	1:45 - 2:05	0:55 - 1:45	0:25 - 0:55	0:25 - 1:10	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 - 1:10 <sup>8</sup>	0:20 - 0:25 <sup>8</sup>		
	75/25	0:30 - 1:20	1:40 - 2:00	0:45 - 1:40	0:20 - 0:45	0:20 - 1:05 <sup>8</sup>	0:15 - 0:25 <sup>8</sup>		
below -14 to -18 °C (below 7 to 0 °F)	100/0	0:20 - 0:35	0:30 - 0:45	0:09 - 0:30	0:02 - 0:09				
below -18 to -25 °C <sup>9</sup> (below 0 to -13 °F)	100/0	0:20 - 0:35	0:10 - 0:20	0:03 - 0:10	0:01 - 0:03				
below -25 °C to LOU <sup>9</sup> (below -13 °F to LOU <sup>9</sup> )	100/0	0:20 - 0:35	0:07 - 0:10	0:02 - 0:07	0:00 - 0:02				

Reference: FAA Holdover Time Guidelines, Winter 2021-2022, Table 19

#### 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 Freezing mist is best confirmed by observation. It is never reported by METAR however it can occur when mist is present at 0 oC and below.
- 3 To determine snowfall intensity, the Snowfall Intensities as a Function of Prevailing Visibility table (FAA-Table 42) 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 and below.
- 7 Heavy snow, ice pellets, moderate and heavy freezing rain, small hail and hail (FAA-Table42 provides allowance times for ice pellets and small hail).
- 8 No holdover time guidelines exist for this condition below -10 °C.
- 9 If the LOU<sup>9</sup> is unknown, no holdover time guidelines exist below -22,5 °C.

#### 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 the 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 pre-take-off check procedures.

#### 4.6 Main apron with VHF frequencies on parking stands and on remote de-icing positions DE-1, TWY N and TWY M

