

De-Ice De-Ice Baby: Cold Weather Opsicles

OPSGROUP Team

8 December, 2021



In the Northern Hemisphere the winter season is well and truly upon us, which means various extra things to think about – like different procedures, low visibility challenges, cold temperature corrections, where you left the other glove, and of course de-icing!

So, to help you out if you aren't so familiar with all things Winter Ops we have put together a little series of **Opsicles** - *Refreshing bits of ops info, just for members.*

Winter Opsicle #1: De-Ice De-Ice Baby

Most operators we've met apply a **"Keep it clean, keep it safe!"** policy meaning *don't risk it; if there is anything on the airplane get it off before you take-off.*

There are some caveats to this – less than **3mm of frost on the underside of the wing** around the fuel tanks is generally acceptable. If you don't have a tiny frost ruler to hand then a general rule of thumb is clear paint markings showing through means it's ok. A light dusting of hoarfrost on the fuselage is also fine (if your manual says so).

The areas where **anything is unacceptable** are your **critical surfaces** – the upper surface of the wings, horizontal stabilisers, leading edge devices... Basically any lift and/or control surface on the aircraft. If you've ever done a Winter Ops Refresher you probably know this statistic off-by-heart but *"a very small amount of roughness, in thickness as low as 0.40mm (1/64in) can disrupt the airflow and lead to severe lift loss..."*



Icicles on leading edge: not good. Frost around fuel take: might be ok.

So keeping it clean seems like a good rule. Alas, a rule not all follow...

The trouble is, it can get confusing (no, that crew in the video weren't confused, just negligent). But when you are out there, under pressure, managing a bigger and more complex workload, it can quickly get complicated especially when you throw in some **variable weather conditions** to the mix, and some **different mixtures into your HOT calculations**.

So our **Winter Opsicle #1** is a handy guide to help with just that.

What's in them?

De-Ice De-Ice Baby is looking at de-icing/anti-icing. It comes in three parts, and you can download all, none, just one depending on what you find helpful.

- **A De-Icing Decision Process** checklist - to help you determine whether or not to consider de-icing/anti-icing.
- **Caution: Hot Stuff** - a sort of FAQ on Holdover Times.
- **Too HOT to Handle** - a generic guide on what HOT to expect.

None of these are designed to be used in place of official (and possibly much more accurate) documents and manuals, but we do hope they will provide some refresher info on things to think about during the winter season.

Over the winter season, we'll try and post more so you can **build up your own Winter and Cold**

Weather Ops Pack.

PE-ICE PE-ICE BABY  **Too HOT to Handle**

We said it once, we'll say it again - these are just to give an idea of **What's HOT and what's not**. Always use official tables, and preferably ones specific to the fluid type.

Here is a space to write where your proper, official manuals can be found so you know where to look on the day:

My official manuals that we use during operations are in:

WEATHER INTENSITY VS. VISIBILITY					
	TYPE (C)	VISIBILITY (MILES/ METERS)			
		HEAVY	MODERATE	LIGHT	VERY LIGHT
NIGHT TIME	1-100 ANYTIME	0.1 500	0.3-0.9 500-1600	1-3 1600-4800	5 8000
	BELOW 10	0.04 500	0.04-0.1 500-1600	0.1-0.3 500-1600	0.3 800
LIGHT TIME	1-100 ANYTIME	0.1 500	0.3-0.9 500-1600	1-3 1600-4800	5 8000
	BELOW 10	0.04 500	0.04-0.1 500-1600	0.1-0.3 500-1600	0.3 800

HOT TABLES

TYPE I GENERIC						
OAT (C)	FEED OUT CAPABLE	HOY LIGHT	LIGHT	WATERING	FOLLOWING PRAISE	LIGHT FEED
3" and above	0-12	00	0-100	0-11	0-12	0-5
3" to 4"	0-12	12	0-10	0-0	0-0	0-0
4" to 10"	0-10	01	0-11	0-0	0-3	0-5
below 10"	0-0	7	0-3	0-0		

DO I NEED TO DE-ICE OR ANTI-ICE?

De-icing is all about clearing off anything cold currently stuck to your aircraft. Check the critical surfaces of your aircraft. Most types allow for less than 3mm of frost on the underside of the wing, around the fuel tank. Anything else – you need to De-ice.

Anti-ice is about stopping stuff from stoking to it before take-off so in the case, **check the weather** and then move onto the next question.

IS THERE
PRECIPITATION?

Precipitation means anything outside that could turn into ice and stick to your wing.

WILL IT STICK?

To work out if it will stick, you'll want to check the outside temperature too - that means the **temperature of the air**, but also whether you might have **cold soaked wings**.

WHAT SORT OF PRECIPITATION?

The sort of precipitation is important. You are going to need to know the **type of solid stuff, and solid it is**, to determine your HGT. Sometimes there are different types - use the worst one (F2PQ or F2PA if they are present).

Flammabar: There might be some precipitation which your aircraft is not approved to operate in.

SNOW CLUE?

Use a **Visibility to Snowfall intensity table** to work out whether snow is heavy, moderate, light or very light. Or make your FO stand outside and time how long it takes for them to turn into a snowman.

WHAT WEATHER?

Don't forget the forecast. Use the ATIS, use your instincts, and make sure you consider what might start falling to the skies before your take-off time. If in doubt, always use the worst case weather NOT.

WHAT IS HOT?

You're going to see a minimum and a maximum. Always use the **minimum** and if you exceed that, then do an inspection. The tables are just to give an idea - use official ones for your fluid type.

DE-ICE DE-ICE BABY

DE-ICING DECISION PROCESS

ANYTIME ON THE GROUND

Are your critical surfaces contaminated/likely to get contaminated?

CONSIDER DE-ICING / ANTI-ICING

TAXI / APPROACHING TIME FOR TAKE-OFF

Has there been any FZFG or precipitation since the START of the FINAL application?

Next question...

Have reports of suspected contamination on the aircraft been received?

CONSIDER DE-ICING / ANTI-ICING

Has the MINIMUM HOT been exceeded?

Next question...

Was Type I only used?

Or

Was Type II, III or IV used, but had a short MINIMUM holdover time?

CONSIDER DE-ICING / ANTI-ICING

CONSIDER A PRE-TAKEOFF CONTAMINATION INSPECTION (PCI)

Is the anti-icing fluid showing signs of fluid failure?

CONSIDER DE-ICING / ANTI-ICING

REMEMBER: Keep it clean to keep it safe!

If you're an OPSGROUP member you can click on each thumbnail to head to the Opsicle PDF download page.

Further reading

There is a huge amount of info out there (from more official sources) including:

- [This](#) very informative AOPA article on all things ice.
- [This](#) FAA Guide for Pilots on de-icing big aircraft.
- [This](#) EASA Safety Bulletin on proper de-icing procedures.
- [This](#) Airbus Manual on Getting to Grips with Cold Weather Ops.

Rolling the dice with de-ice

OPSGROUP Team
8 December, 2021



Snow might look lovely on a Christmas card, but on the wing of an airplane (especially if it is the wing of the airplane you're about to go fly in, and *especially if it is 3am and you've got a long flight ahead of you*) then I think we can all agree it is less 'pretty winter frosting' and more 'horrid winter frustration'.

Snow, ice, sleet, hail - basically anything made out of really, really cold water means one thing - **delays!** Sorry, I meant to write **de-icing** there.

Feeling frosty

There are a few reasons why folk feel frosty about de-icing. **First, it is a bit annoying - it does often mean delays.** It also means extra things to think about, work out, and worry over. De-icing is an extra, and often slippery step, in an otherwise nicely structured turn-around.

Secondly, it is pricey. De-icing and anti-icing fluids are expensive stuff. For a small private jet you are probably looking at about \$1200 , and more like \$15000 for a large airliner. The call out fee alone is generally a few hundred bucks, and although we all have safety as a priority, most of us have called the de-icing rig out only to watch them spray copious amount of fluid all over the place while we wonder whether that little patch of frost on the wing really wouldn't have melted off as we taxied out.

Lastly, and maybe not one everyone worries about, but anything with glycol in it creates high level of biochemical oxygen demand. What does that mean? Well, just that it is a bit bad for fish or anything that lives in water and likes to breath oxygen. **So it ain't the friendliest stuff for the environment.**

Let's be honest though, **point 2 (with a bit of 1 thrown in) are probably the main reasons** why we sometimes wait, fingers crossed, and fuel pumps a-swilling in the hope it just melts off before we go.

De-ice-iding to go

There is of course a big reason why we do need to de-ice. We are all fairly well aware of it – **safety!** Or more specifically – **performance!** Because a little bit of ice means a big bit of (lost) lift. (*Don't worry, not an icy accident movie, just a video of a poor de-icing decision*).

Let's re(snow)cap on it

Most airlines and operators apply something close to a “clean aircraft” policy, which means that all **critical surfaces should be clear** of contaminant.

Simple – see something on a bit of the airplane that's used for getting the airplane up in the air? **Get it off before you go.** This rule applies to bits like the wings, the horizontal stabilizer, and don't forget in the engines – ice shedding after a prolonged taxi in wintery weather is going to help shake off any chunks of ice clinging to them.

Back to those critical surfaces though – if you see a bit of frost (less than 3mm thick and so you can see the paint markings through it) underneath the wings? **That's ok.**

Look out for **clear ice** – not always very visible (being *clear* and all).

So, step 1 in the “Do I need to de-ice?” decision making process is pretty straightforward:

- Is there ice or contaminant anywhere on the airplane?
- Is it more than a little bit of frost on the underside of the wing?
- Is it more than really thin layer that won't melt once warmer fuel is added in, or with the airplane sat out in the sunshine?

If you answer 'Yes' to any of these then you probably need to de-ice. If you're not sure, get a second opinion from your co-pilot or engineer.

Snow idea if you need to anti-ice?

De-icing is the process of getting any contaminant off. Sometimes blowing hot air is enough, sometimes a Type I fluid is used to melt it off. This one-step process is fairly quick and unless there is a big old queue you probably won't be delayed too much.

Anti-icing comes in when there is a chance ice and stuff will build up again. So if you send the FO out on the walk around and they return red nosed with icicles on their eyebrows then you probably need to anti-ice as well. Simple in theory: **de-icing takes it off, anti-icing stops more getting on.**

So what options do we have for this, aside from wrapping the airplane up in a giant woolly sock until it is time to take-off?

Well, you have **four types of de-icing/anti-icing fluid options** open to you. Not all airports will carry all options so if you think you need something specific, check with an agent before heading there. These four fluids are all typically made out of ethylene glycol or propylene glycol, with a bunch of thickening agents, wetting agents, corrosion inhibitors, colors and some UV-sensitive dye thrown in.

- **Type I** ain't gonna give you much of a holdover time, but it's useful for clearing stuff off. If applied heated it does provide some anti-icing protection as well. It is usually orange. The good thing with this stuff is it is thin and shears off easily so there is no restriction on your

rotation speed.

- **Type II** is clear or strayed colored and needs at least 100knots rotation speed. Its pretty common to see this being used either 100% or diluted to 75%, and as part of a two step process.
- **Type III** is less common. This yellowy green fluid as a much lower rotation speed requirement – just 60 knots – so its good for smaller, slower aircraft.
- **Type IV** is your good ‘n’ thick stuff, great for longer hold over times, less great for aircraft that rotate slower than 100 knots.

Our top tip: *Let your passengers know you’re going to de-ice. If they haven’t seen it before, having dinosaur like rigs pull up to the airplane, or seeing the windows fog up with thick smoky smoggy fluid has been known to panic one or two..*

HOT Stuff

Your HOT – ‘Holdover Time’ – is what we really worry about when we need to anti-ice. **There is no definite “this fluid will last this long” calculation.** Instead we have tables for checking how long you’re probably ok for, depending on a few factors:

- What sort of fluid was used.
- Whether it was diluted.
- What is going on outside.

The table is going to give you two times – a minimum and a maximum, and **your best bet is to take the minimum one** and if you reach it, take a look at your critical surfaces and see what is going on with the fluid. Actually, a pre-departure contamination inspection is mandatory in most cases. If its look ok (really looks ok) then you’re good to takeoff. Exceed that though and you’re going to need to taxi back, clear it off and start over.

In nasty conditions, keeping an eye on the fluid and the hold over times is super important. There are actually **no published HOTs for anything more than light freezing rain.** Snow pellets and hail also get messy because these sticky morsels and strong and like to stick to anti-icing fluid, instead of getting melted by it.

If you are looking at rain or **light freezing rain on cold soaked wings** then your HOT could be as low as 9 minutes. If you have snow pellets or snow grains bouncing off the windows, and it is colder than about -14°C (so anywhere in Canada, Russia etc in the midst of winter), then these blighters are going to reduce your HOT to as little as 1 to 2 minutes (good luck getting anywhere in that time!)

Hitting the hold over time might suck, but there isn’t much you can do about it except call the cabin for another, stronger coffee, and settle in for a long, cold flight.

Another top tip – *check those HOTs and if they are unrealistic then wait for the weather to clear, ask for remote de-icing, go for a different fluid dilution... whatever you do don't ignore it though and think it'll all be ok.*

Messing with your schedule

Back to Point 1... or was it 2? The one about **delays and messing up of your schedule.** Winter weather is going to mean delays. There are no two ways about it. The extra steps added into our pre-flight process

also raises the risk of forgetting bits we need to do. So here is a handy checklist of items to remember to remember:

- **Flaps** - we usually leave these up for the de-icing process, and to avoid picking up any chunks of ice during the taxi. Don't forget to set them before you try to take-off.
- **Control checks** - often recommended that you do these after de-icing to make sure there are no sticky fluids gumming up your flight controls.
- **The gear** - if you are taxiing through slush and sludge then check that performance and if possible, leave the gear down just a little longer to let all the pieces drop off before retracting.

The future looks cold

So de-icing delays aren't going away anytime soon, but there are some interesting technologies out there being trialled.

Our favorite is this one - originally developed as a de-frosting method for cars, it could eventually be applied to aircraft too. It works off the principle that ice actually has an electric charge, so the idea is if you pass a big charged-up electrode over a frosty surface, it will remove it.

This isn't a totally new idea either, inflight de-icing technologies are also starting to look at using electromagnetic induction over traditional heating methods to prevent ice build up.

Until then, all we can do is **buy a big cup of coffee** from the airport, prepare for a long wait, and remember to **"keep it clean" (and safe)**.

Fancy reading a bit more?

- International Airport Review have an interesting Winter Operations talking about the airport side of de-icing that is worth a read if you want to know what goes on on the other side of the windows when you're getting de-iced.
- Canada and the US publish info each year on HOTs and de-icing guidance. You can find links to those [here](#).
- OPSGROUP article: 5 Tips For Safer Winter Ops.
- OPSGROUP article: Fuel Facts: Let's get to the (freezing) point.

Winter Is Coming

Declan Selleck
8 December, 2021



“Well, we have a question for you.” The New York Center controller seemed amused.

“Go ahead,” I replied, my voice made uneven by the moderate turbulence we were bouncing around in. As I answered, I cast another look over my shoulder at the ice on the wings. **The Dash-8 boots were doing their job, at least for now.** The aircraft took on a bit of shudder as the props flung ice unevenly off of the blades.

The Center controller delivered the news with a mixture of ironic humor and pity. “Williamsport wants to know if you want them to plow the runway. They say they are closed currently. They have four inches of snow on the runway, but there is a hard crust of ice on top.”

I quickly retrieved the flight release and rifled through the six foot paper scroll to find the NOTAMs. Nothing about the airport being closed, thank Zeus. At least I didn’t miss something big like that. Dispatch should have known—but here we were, halfway between Philadelphia and Williamsport, in and out of freezing rain. I eyed the fuel gauges critically. Plenty left to get there and fly back, if need be. At least there was that.

“Well yeah,” I told the controller. “Plowing the runway would be helpful.”

That night ended with a circling approach to minimums through a narrow valley in light freezing rain mixed with snow. The First Officer flew the approach perfectly, and thanks to the superior stopping power of the Dash 8 we had plenty of slick runway left to play with. Just another Northeast U.S. winter night—par for the course from November until March.

Winter is coming. In some parts of the world, winter is already here and people are insistent on staying inside on top of their twin mattress. However, for pilots, they still have to brave the weather. Flying always brings challenges, but winter supplies extra problems that separates mere pilots from imaginative problem solvers. Problem solving must always be wrapped in a healthy rind of risk analysis. When things go bad in winter weather, they often go bad in a big way.

The accident record is filled with examples of the problems that ice and snow can cause. The American Eagle ATR in Indiana in 1994 was brought down by the crew’s lack of appreciation for the extreme effects of super-cooled large droplets (SLD). In 2005, Southwest Airlines slid off of the end of a slick runway at Chicago Midway. There have been icing induced loss of control events the world over and a few aircraft seem to slip off of the taxiway every winter. Sometimes, simply the additional worry and workload posed by extreme winter weather can add risk. A crew can find themselves rapidly being overcome by events, leaving little time to make decisions in a highly dynamic environment.



Technology has come a long way in helping to mitigate the risks that winter can pose. There are now predictive charts for SLD that pilots can examine prior to flight. Deice and Anti-ice fluid technology has improved in past years; there are now three different types of fluid available for use, each tailored for a specific application. The holdover times (the amount of time that fluids remain effective) are revised on a yearly basis as formulations change and the science improves. Some airports are even experimenting with large heaters and infrared deicing technology. Predictive weather tools are much better as well, leading to proactive cancellations that allow aircraft to be positioned for relatively rapid system recovery once a major winter storm has passed.

But there are still problems ... Even the best anti-icing fluids can rapidly lose effectiveness in the right conditions; temperatures near freezing with high humidity makes for large, wet flakes that can quickly saturate even the most robust Type 4 fluids and render them useless. Weather systems can capriciously change course with little warning, meaning the difference between a snow apocalypse and a mild dusting of white. Winter is expensive too, with deicing and anti-icing fluids costing more per gallon than jet fuel. Duty days get longer, crews get fatigued, schedules lag and dispatchers become swamped with work. There is nothing more expensive than operating a late airline, and late is often the rule rather than the exception when it comes to winter operations.

So, what is the key to safe winter operations? Planning is essential, but so is flexibility. Many airports have instituted gate hold programs for deicing operations, which helps prevent needless burning of jet fuel on the taxiway. Proactive assessment is key. Knowing the conditions at the destination prior to departure can mean the difference between a successful outcome and tens of thousands to dollars of expense for a divert to an alternate. Caution is the most important concept. Aircraft performance numbers are important, but takeoff and landing distance data should be taken with a grain of salt: it is not uncommon for conditions to vary significantly along the runway length, especially at smaller airports with limited snow removal capabilities.

Planning and caution can mean the difference between a successful, safe operation and having to have a crew have to get creative in the middle of the night. Winter is coming. Time to get ready.