Winter Ops: Fun Fuel Facts

OPSGROUP Team
29 November, 2024

Fuel is to airplanes what coffee is to pilots – something you just cannot fly without. But just as there are different types of coffee, you're going to come across different types of fuel as well…

The Menu

Jet-A1 – The most traditional drink, it is straw coloured with a flash point of 38°C (100°F), and a freezing point of -47°C.

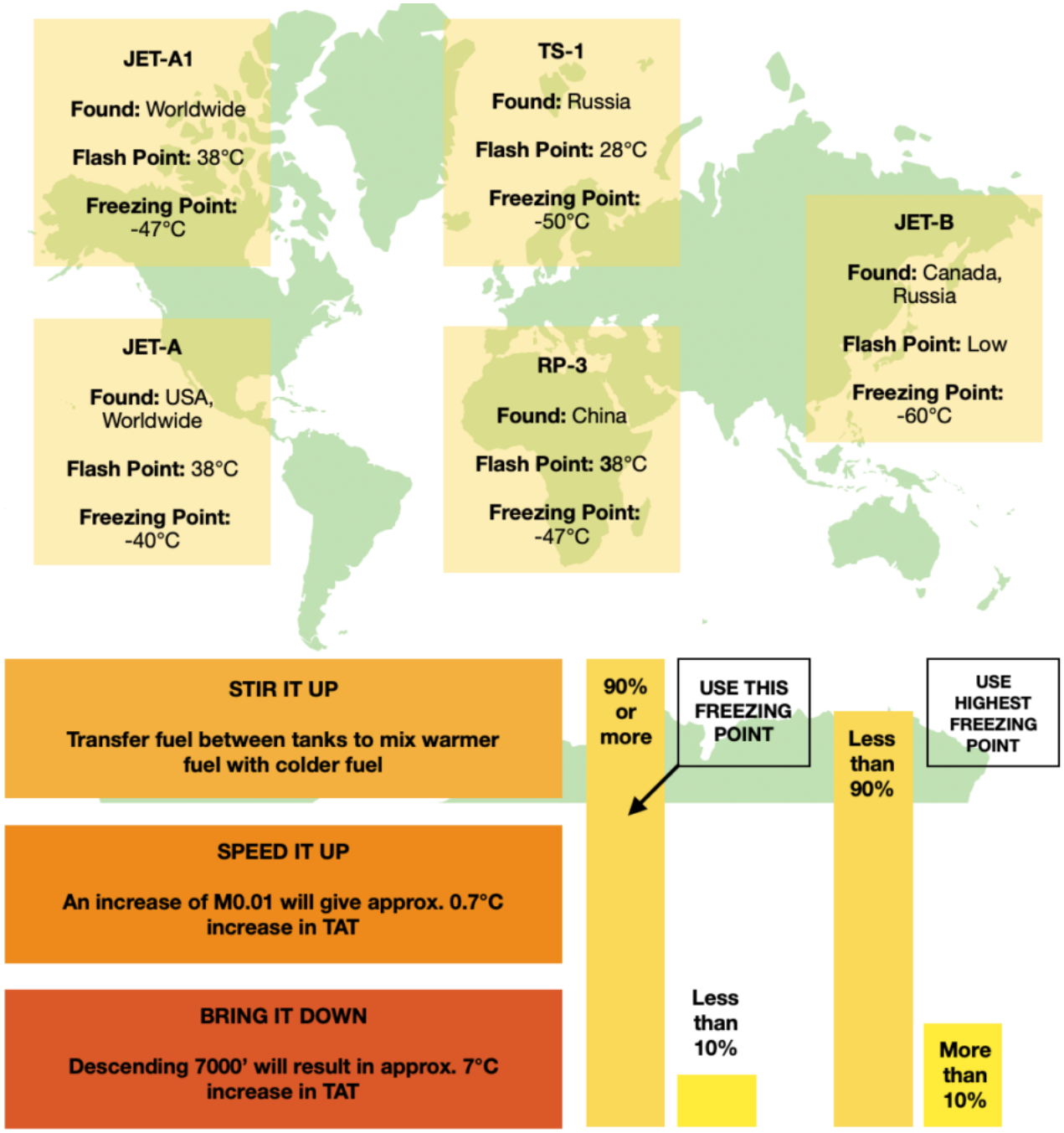
Jet A – Another tasty kerosine grade fuel which will work just fine. The flash point is the same but this turns into an icy slushie at only -40°C.

Jet B – A delicacy from the Northern Regions. This is a cocktail of kerosine and naphtha – the stuff dragons produce out their nostrils (ok, that is not true, but it might as well be because this stuff is hard to handle with its higher flammability). Wide cut, and only really used in colder climates, with its freezing point of -50°C.

TS-1 – A Russian cocktail, more flashy than most at 28°C, but with a freezing point of -50 °C. It is also sometimes called RT (which looks like PT when it is written in Russian). RT is a superior grade TS-1, but not widely available.

RP – Brewed in China, the RPs come in a variety of styles. RP-1 has a freezing point of -60°C, RP-2 -50°C, but it is RP-3 we really recommend because it is basically Western Jet-A1 produced at export grade.

Chip fat oil – Not literally, but if you fly into a remote airport in some regions you might find fuel is not of the standard required. Look out for anything that isn't straw coloured, doesn't smell right, or has things floating in it.



Cutting it wide

Wide cut fuel is a mixture of kerosene and gasoline (Jet A1 in comparison is highly refined Kerosene). Wide cuts are not often recommended by airplane manufacturers because the quality and performance specifications are generally not as good.

If you are going to use it, there are likely going to be some pretty specific operational procedures involved because these fuels are much more volatile. Things like over-wing fuelling is generally a no-no, and the filtration system is going to appreciate a slow flow so it can keep up.

All those numbers

Fuel doesn't freeze like water. It is not liquid one minute and ice the next. Instead it turns into a strange, slushy porridge consistency.

What's more, if you have a mixture of freezing points, the freezing point won't be a nice in the middle -44.5°C so the only reliable way to work this out when you've mixed a load together is to take a

measurement – assuming you're carrying your own Fuel Freezing Point Measuring Gadget…

If not, the next best method to use is this –

- **90% or more of your fuel is one type?** Use that freezing point.
- **89% or less of your fuel is one type?** Use the highest (worst case) freezing point.
- **You have 900 gallons of Jet A1 freezing at -47°C and 100 gallons of Jet A freezing at -40°C?** Then call it -47°C and be off on your merry way.
- **You have 899 gallons of Jet A1, and 101 gallons of Jet A?** Then take the highest freezing point which in this case would be Jet A at -40°C

Do we really care about freezing points of fuel?

Yes, very much so, especially if you are flying some long haul treks over the North Pole at high altitude in the winter.

With outside air temperatures lower than -60 degrees, freezing fuel can get you into some very hot water, (or cold fuel to be more accurate.)

In Jan 2008, British Airways Flight 38 crashed just short of the runway at EGLL/Heathrow after flying from Beijing, China. They had been cruising between FL350 and FL400, with OATs reported to be between -65 to -74°C. While the fuel itself never froze, it did become cold enough for ice crystals to form in the fuel system.

These pesky little ice particles blocked stuff up and reduced the fuel flow, starving the engines, and causing a big loss in thrust right when the pilots needed it.

TUDNU	PARAS	ROVON	PAREX
N3753.0	N3731.6	N3716.0	N3605.5
E04444.8	E04541.6	E04553.4	E04651.9
410 262/087 -60	410 266/095 -61	450 265/076 -61	450 270/088 -64
390 259/104 -59	390 261/113 -59	410 266/098 -61	410 267/113 -61
370 259/106 -57	370 261/114 -57	390 262/115 -59	390 263/121 -59

KEBEP	NOTSA	RADID	IMGOD
N3504.9	N3317.8	N3024.7	N3014.3
E04740.2	E04903.3	E05126.2	E05130.8
450 272/100 -65	450 275/121 -67	450 281/131 -68	450 281/130 -68
410 268/124 -62	410 271/139 -63	410 279/139 -63	410 280/138 -63
390 266/120 -60	390 271/128 -58	390 280/134 -57	390 280/132 -57

DASDO	LAGSA	LAM	T_O_D
N2854.0	N2833.1	N2722.4	N2702.1
E05205.9	E05220.9	E05311.0	E05317.3
450 282/123 -69	450 283/121 -69	450 287/116 -70	NO WX DATA
410 282/127 -62	410 282/124 -62	410 285/116 -63	NO WX DATA
390 282/122 -56	390 282/119 -56	390 284/110 -56	NO WX DATA

DESCENT
390 288/092 -56
350 285/085 -47
310 286/082 -37
200 307/058 -13
100 327/027 P08

The temperature gets darn cold at altitude!

What can we do about it?

Ultimately, you need to **turn up the temperature!** There are only a few ways to heat your fuel up if it starts getting too chilly:

Stir it Up – Unlike Bond who preferred his drinks shaken and not stirred, mixing cold fuel with warmer fuel makes it better. Some larger aircraft with complex fuel systems do this automatically, but if you are able to do so manually there will probably be a checklist and following it to avoid turning off the wrong pumps might be wise.

Speed it Up – Flying faster means more drag which means more energy converted into hotness. Not much though… an increase in Mach 0.01 will increase the TAT by around 0.7°C, and increasing your speed also increases your fuel burn.

Bring it Down – Warmer air will help, and by descending 7000’ you can increase the TAT by around 7°C. In seriously cold air masses, descent to at least FL250 might be required, but this all means a much higher fuel burn.

Tanker? No thank ya…

Tankering fuel if you are operating into somewhere chilly might cause you some problems. The fuel is likely to get cold in flight, and up the likelihood of some frosty wings on the ground. So check the de-icing situation at your destination if you are tankering and it’s cold out.

Some other useful info

- 1 imperial gallon = 1.2 US gallons.
- You can monitor the price of jet fuel here.

Winter is Coming: Updated Holdover Time Guidelines

OPSGROUP Team
29 November, 2024

Sorry, the GoT reference still hasn't grown old. Anyway, every year the FAA & Transport Canada releases a new set of Holdover Time (HOT) guidelines for the winter season. The one for winter 2022 is available here. So if you want to update your de-icing procedures, manuals, and training in line with the guidance from the feds, here's what you need to know…

What's changed?

They've added some fluids and removed some fluids which are really good for *middle speed aircraft.* So basically, check what fluid is being used on your aircraft, confirm it is a good one for your aircraft Vr, and then make sure you use the right table.

Standard Winter Ops 101.

Type II generic holdover times have increased (because they removed a fluid called *Beijing Something or other* that was holding them back). How much by? A few minutes here, a few minutes there, mainly in the -3 °C and above (27 °F and above) section.

They also did a load of tests which means you now get **HOTs for very cold snow** (cold enough to turn

your legs to ice blocks if you accidentally step into it because its colder than -14°C cold). This applies to a bunch of new Type II and IV fluids and is great because that's the sort of stuff you're going to want to escape from for sure.

Double check those tables!

If you're heading into the **generic fluid tables** then that's fine **but** you actually need to **make sure the Type II or Type IV fluid is listed in table 55 or 57.**

It might seem a little contrary to the point of a 'generic table' but there we go. If it isn't in the table, and if it doesn't have its own specific table, then chances are you're in some dodgy airport where they're spraying you with homemade, bootlegged moonshine and it might not be very safe.

Freezing Fog.

There are changes to the HOTs for **FZFG if it's mixed with ice crystals or mist.** Same for snow mixed with ice crystals.

My opinion: *You need some pretty trustworthy Met officer telling you exactly what is out there to start getting this specific. If in doubt, always go with the most limiting and then take a good look before taking off!*

A note on a note.

You can takeoff up to 90 minutes after the start of fluid application with a few conditions. This isn't a new change, this has always been the case, but still worth mentioning.

- 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: light freezing drizzle, moderate freezing drizzle, light freezing rain, or light rain.

Small Hail.

This hasn't changed but it is a confusing one so they've added a new note on it. It says this (give or take one or two inaccuracies):

- **GR** in the Metar means small hail, which means hail less than 1/4 inch… **if you're in the US.**
- **Outside the US**, small hail is anything less than 5mm, and is reported as **GS**. If it says GR that means big hail (5mm or more). Don't get them mixed up.
- If it doesn't specify intensity then use the moderate ice pellets or small hail times.
- If you aren't sure and don't have a tape measure then send your FO out and check the bruise sizes when they return.

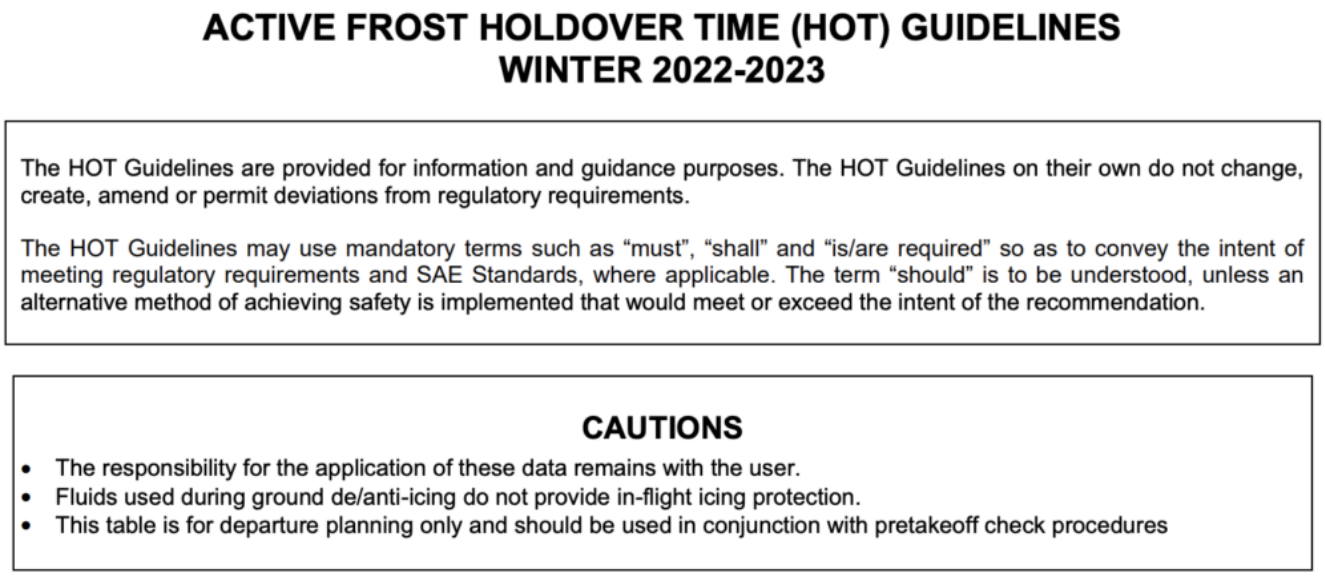
'Snowfall intensities as a function of prevailing visibility'.

You know the one – they use it in your yearly Winter Ops sim to try and catch you out by overcomplicating which table you want to use and hoping you forget or get confused and then they can enjoy lecturing you on it during the debriefing…

Anyway, it has been *changed, reformatted and updated.* Compare them at your leisure. We like the new one much better.

Must, shall, required, and should…

The document has **these new disclaimer sheets** at the start of each section:



ACTIVE FROST HOLDOVER TIME (HOT) GUIDELINES
WINTER 2022-2023

The HOT Guidelines are provided for information and guidance purposes. The HOT Guidelines on their own do not change, create, amend or permit deviations from regulatory requirements.

The HOT Guidelines may use mandatory terms such as "must", "shall" and "is/are required" so as to convey the intent of meeting regulatory requirements and SAE Standards, where applicable. The term "should" is to be understood, unless an alternative method of achieving safety is implemented that would meet or exceed the intent of the recommendation.

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

In case you aren't familiar with these nuances of aviation lingo, here you go:

- **Must:** Really no grey area. You gotta do it no question, no bending, no ignoring. Just do it.
- **Shall:** A little bit more ambiguous – not quite the same level of necessity but a strong assertion of importance!
- **Required:** More a *regulatory, meeting standards* sort of a thing. If you want to two step de-ice then some de-icing fluid is required. You can try without but won't get very far…
- **Should:** A wonderful word but don't get carried away – it's more of a "really should unless you really can't" rather than an "only if you fancy it" sort of a meaning. So a shall *unless you have a good reason not to.

A final thought.

Don't forget GRF changed in November 2021. You might not have operated in conditions needing a runway surface condition assessment since then so it's worth a quick read of what it now looks like.

Also, thanks to **Avioscribe** for this handy video on the main highlights and changes to the Holdover Time Guidelines for Winter 2022-2023. Trying to compare the two documents was a mission we weren't prepared to undertake and you've done a spot on job.

Rolling the dice with de-ice

OPSGROUP Team
29 November, 2024

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 if off before you go.** This rules 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 than 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 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-icng 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 its 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 though 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.