

Fuel Facts: Let's get to the (freezing) point

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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...

Did you ever hear about cat poo coffee?

Yep, there is a coffee made from beans pooped out by weird jungle cats. Had it, doesn't taste great.

There are also a range of fuel varieties that can be used for turbine aircraft. It isn't just your standard Jet A1 that you might find on offer, and not all are going to be suitable for your aircraft or operation.

Fuels are generally categorised not by what they're made of (a bunch of different hydrocarbons), but on the performance specifications they have.

Only ever feed your airplane the fuel types that are approved in your flight manual, but here's a little recap in case you do not recognise the items on the menu.

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.

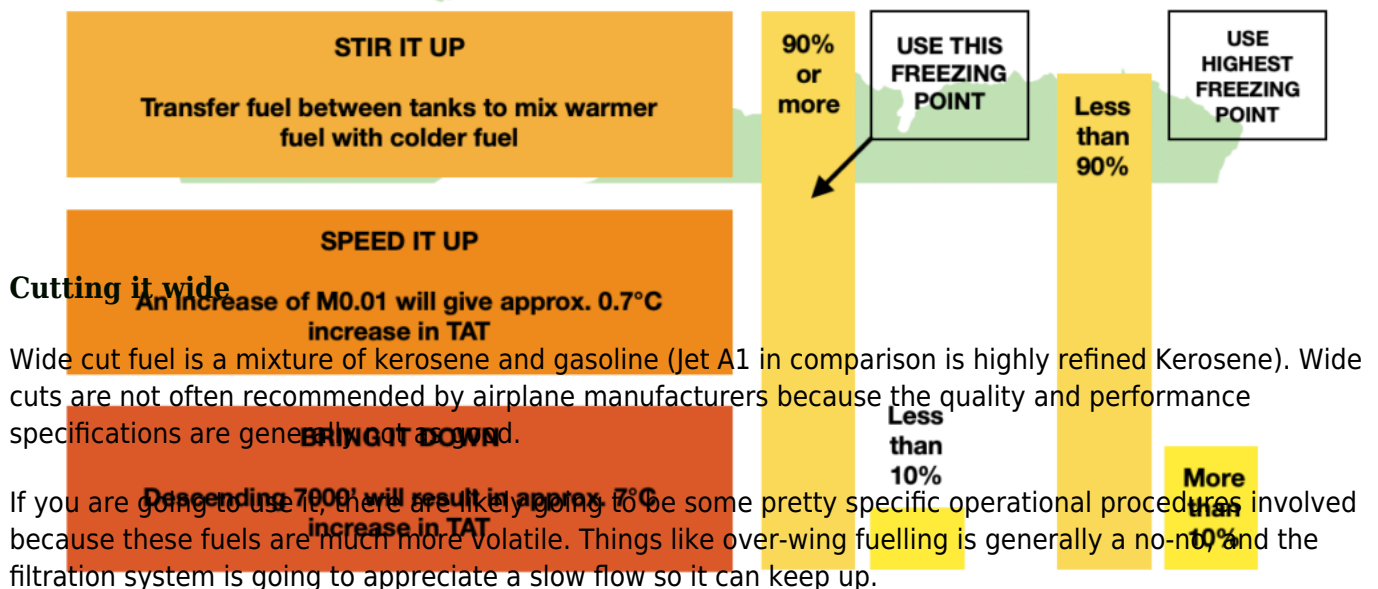
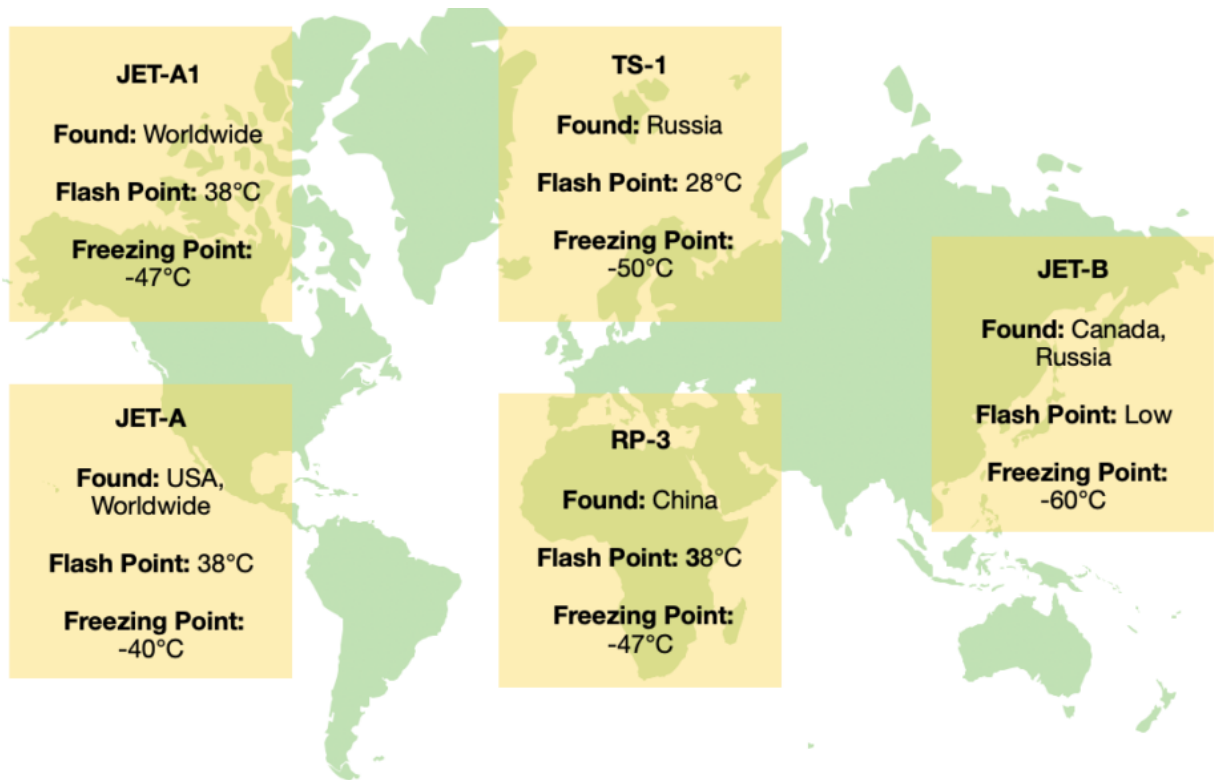
Jet B – A delicacy from the Northern Regions. This is a cocktail of kerosine and naphtha – the stuff dragons produce out their nostrils (ok, that is not true, but it might as well be because this stuff is hard to handle with its higher flammability). Wide cut, and only really used in colder climates,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



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](#).