

Freezing Precipitation (freezing drizzle, freezing rain)

Freezing precipitation is an area that often leads to misunderstandings.

Von Capt. Dominic Z'graggen

It is possible to perform an anti-icing treatment in case of freezing drizzle (-FZDZ, FZDZ) or light freezing rain (-FZRA) and holdover times (HOT) apply. But the existence of HOT **does not imply that it is safe to fly** in those conditions. The bottom of every HOT table contains the following quote: *"Fluids used during ground de-icing/anti-icing do not provide in-flight icing protection."* (1) That's because the protection of anti-icing fluids is only valid until the shearing speed (close to V rotate). After lift-off, nearly all of the anti-icing fluid has flown off the wing, and thus no more ice protection is granted by the fluid. In-flight, the aircraft de- or anti-icing equipment (thermal) is the protection against icing. But: There are certain forms of icing (SLD – see below) which can accrete aft of ice protected areas, or even on unprotected areas of the wing and on the horizontal stabilizer and the rudder. If an aircraft is safe to fly in certain conditions or not can only be answered by documentation of the aircraft manufacturer, meaning in OM-B/FCOM or other, e.g. company-wide, documentation, not by the existence of holdover times.

Freezing precipitation does not necessarily NEED to be a safety concern. What is a safety concern is supercooled large droplets (SLD). Definition: Water drops with a diameter greater than 50 micrometers (0.05 mm) that exist in a liquid form at air temperatures below 0 °C. SLD conditions include freezing drizzle drops and freezing raindrops. So SLD can occur in freezing precipitation but does not need to.

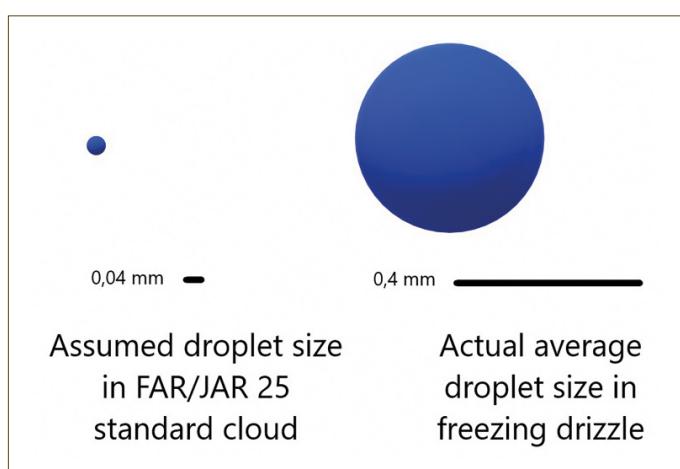
Until now, none of the currently most common aircraft types (such as Airbus A32F, A330, A340, Boeing B73F, B767, B777)



explicitly state in their OM-Bs that the respective aircraft is safe to fly in freezing precipitation conditions. Neither does it deny this operation. Embraer is the only manufacturer that had explicit statements in the documentation on the operation in freezing precipitation, but it is rather legal than operational. ("This aircraft is not designed for flight into FZRA, FZDZ").

Background

- Freezing drizzle (-FZDZ, FZDZ, +FZDZ) and light freezing rain (-FZRA) are two precipitation types that can include water droplets that are liquid, but below 0°C, so-called supercooled large droplets (SLD). Those droplets freeze upon impact with any surface. (Blitzeis).
- On aircraft surfaces, this form of icing may be beyond the capability of the on-board in-flight de-icing equipment, meaning severe icing. The accreted ice may cause very rapid and dangerous stall speed, weight and drag increases.
- Transport Canada states: *"Takeoff into known freezing drizzle and/or light freezing rain is outside of the flight envelope for which any airplane currently operating is certificated."* (1) and *"nothing in the current regulations and standards authorizes, nor strictly prohibits, takeoff during conditions of freezing drizzle and/or light freezing rain."* (2)
- There have been at least 2 aircraft accidents with total loss which are assigned to freezing precipitation: ATR72 in 1994, EMB110 in 1997. Additionally, 2 A321 incidents in 2002 with control problems, uncontrolled roll due to ice accumulation in areas which do not have anti-icing protection (stabilizer, wing behind the heated area) after encounter with SLD. (2)



Fortsetzung

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- The protection against this form of icing was not covered by the relevant certification standards (FAR 25, JAR 25, Appendix C), so the aircraft manufacturers generally do not make statements concerning operation in FZDZ and -FZRA. There has been an EASA Notice of proposed Amendment to "solve" that issue: *"Although there are no documented fatal accidents in the EU caused by the specific severe icing environment, we consider that the safety threat is present with an equivalent probability as established by the FAA and that Certification Specifications must be updated to better protect new aeroplane types."* (3) In 2014, a new appendix O to part 25 of FAA certification standard became effective in order to address SLD certification for new, transport category airplanes, but SLD has not yet been incorporated into the certification of other aircraft types. So, this does not change the status for in-service fleets.

Summary

There is a meteorological phenomenon, called supercooled large droplets (SLD), that exceeds the certification envelope of most current airliners.

NASA online CBT on icing (4) states: *"Certification for flight into icing does NOT mean that the aircraft is capable of safe flight through SLD. Under these conditions, ice may accrete aft of the protected regions. Your aircraft's ice protection system may not be able to adequately protect the aircraft from the effects of SLD."* Also FAA states: *"Airplane certification for flight into known icing conditions does not include freezing drizzle and freezing rain. [...] These conditions are very dangerous and can cause ice to form behind the protected areas."* (5)

Transport Canada, which is known to have a very advanced winter operations knowledge, has issued a Civil Aviation Safety Alert, stating that *"consider the severity, and horizontal/vertical extent of icing conditions and assess safe exit strategies (the best alternative may be to wait it out on the ground)"*. (6) EASA followed with a Safety Information Bulletin that recommends: [...] *"If possible, avoid dispatch or takeoff during freezing precipitation (FZRA, FZDZ, etc.) conditions."* (7)

Some airlines have followed these recommendations and do not allow take-off into areas of suspected SLD, which can be found in -FZRA and FZDZ conditions (e.g. LH). Other airlines permit themselves such operations with the justification that until today no incident with SLD has occurred. But in a modern safety manage-

ment system, this kind of reasoning is not state-of-the-art. Today's aviation tries to avoid accidents before they happen.

So, from a pure safety perspective, the recommendation would be to follow EASA and TC recommendations and wait for the -FZRA/ FZDZ condition to disappear, which they typically do after 30-60 minutes.

Similarly, there is anti-icing treatment against ice pellets, the so-called allowance times (similar, but not exactly the same as holdover times). Here, FAA states *"ice pellets by themselves are not a hazard to the airframe with respect to icing, but a ground observation of ice pellets could indicate Supercooled Large Drops (SLD) aloft."* (5)

Sources:

(1) Transport Canada Safety Letter 2009, "Takeoff in Conditions of Freezing Drizzle and/or Light Freezing Rain (Fixed-Wing Airplanes) I"

https://tc.gc.ca/sites/default/files/migrated/tp185e_4_2009.pdf

(2) Transport Canada Safety Letter 2010, "Takeoff in Conditions of Freezing Drizzle and/or Light Freezing Rain (Fixed-Wing Airplanes) II"

https://tc.gc.ca/sites/default/files/migrated/tp185e_1_2010.pdf

(3) EASA NPA 2011, Large Aeroplane Certification Specifications in Supercooled Large Drop, Mixed phase, and Ice Crystal Icing Conditions

<https://www.easa.europa.eu/sites/default/files/dfu/NPA%202011-03.pdf>

(4) NASA: Aircraft Icing Training (free online course)
<https://aircrafticing.grc.nasa.gov/index.html>

(5) FAA Advisory Circular 91-74B, 2015 Pilot Guide: Flight in Icing Conditions

https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-74B.pdf

(6) Transport Canada, Civil Aviation Safety Alert 2011-01, Ground and Airborne Icing

https://tc.gc.ca/sites/default/files/migrated/casa_2011_01.pdf

(7) EASA Safety Information Bulletin 2011-22, Ground and Airborne Icing

<https://ad.easa.europa.eu/ad/2011-22>