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Pilot View on On Ground Icing and Hold-over Time (HoT)

Capt. Jussi Ekman

Cold Facts

On Ground Icing may cause…

- ✈ (Too?) Long takeoff run
- ✈ Loss of lift / Increased stalling speed
- ✈ Assymmetric lift
- ✈ Control problems – even LOC
- ✈ Foreign Object Damage - FOD

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Mental Preparation

- Many of the on ground icing accidents and incidents happen due lack of proper de-icing.
- In many cases mental (situational) awareness of the flight crew has been a causal safety factor.

Operators

Time to wake up your flight crews and ground personnel for the winter OPS !

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Wake-up call !

Avoid winter shock by adequate

- Training

  (simulator, CBT, class room lecture)
- Information leaflet(s)
  - Becoming winter: OPS, changes, etc
  - Responsibilities
  - References / Links to manuals

Snowhow on the Aerodromes

- Aerodromes should have equipment for checking the wings and stabilizer
- High wing or T-tail aeroplane are challenging !

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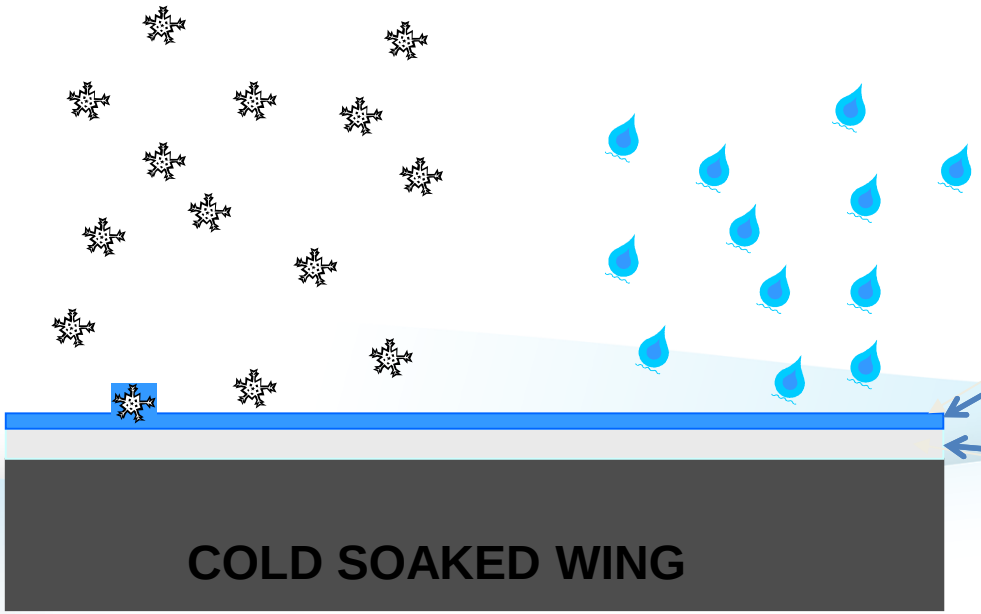
Clear ice – 4 Ds !

- ✈ Dangerous &
- ✈ Difficult to Detect in Darkness
- ✈ Transparent
- ✈ May form & exist above 0 °C



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Sufficient Resources

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Efficient Snow Removal

…guarantee minimum delays

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Line Operations

- Environment:
  - Reduced visibility
  - Snow and snow banks obstructing signs and markings
  - Engine icing during taxi
  - Reduced braking efficiency
  - Challenging T/O performance calculations
  - Delays and slowed operations

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Hold-over Time - HoT

- The estimated period of time for which an anti-icing fluid is expected to prevent the formation of frost or ice and the accumulation of snow on the treated surfaces of an aeroplane on the ground in the prevailing ambient conditions.

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Watching the HoT

- Enter OAT, weather and Fluid used
- Seems easy & straight forward, but…

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

OAT 7)		Type II Fluid Concentration Neat-Fluid / Water (Vol%/ Vol%)	Approximate Holdover Times Under Various Weather Conditions (hh:mm)						
°C	°F		Active Frost	Freezing Fog	Snow / Snow Grains / Snow Pellets (1)	Freezing Drizzle (2)	Light Freezing Rain	Rain On Cold Soaked Wing	Other (3)
-3 °C and above	27 °F and above	100/0	(6)	0:35-1:30	0:20-0:45	0:30-0:55	0:15-0:30	0:08-0:40 (4)	
		75/25	(6)	0:25-1:00	0:15-0:30	0:20-0:45	0:10-0:25	0:05-0:25 (4)	
		50/50	(6)	0:15-0:30	0:05-0:15	0:08-0:15	0:05-0:09		
Below -3 to -14 °C	below 27 to 7 °F	100/0	(6)	0:20-1:05	0:15-0:30	0:20-0:45 (5)	0:10-0:20 (5)		
		75/25	(6)	0:25-0:50	0:10-0:20	0:15-0:30 (5)	0:08-0:15 (5)	**CAUTION: No Holdover Time Guidelines exist**	
Below -14 to -25 °C or LOUT	below 7 to -13 °F or LOUT	100/0	(6)	0:15-0:35	0:15-0:30				

(1) In light "Rain and Snow" conditions use "Light Freezing Rain" holdover times.

(2) If positive identification of "Freezing Drizzle" is not possible use "Light Freezing Rain" holdover times.

(3) Other conditions are: Heavy snow, ice pellets, moderate and heavy freezing rain, hail.

(4) No holdover time guidelines exist for this condition for 0 °C (32 °F) and below.

(5) No holdover time guidelines exist for this condition below -10 °C (14 °F).

(6) For holdover times under Active Frost conditions see the separate frost table.

(7) Ensure that the lowest operational use temperature (LOUT) is respected. Consider the use of Type I fluid when Type II fluid cannot be used.

CAUTION: 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 also be reduced when the aircraft skin temperature is lower than OAT. Therefore, the indicated times should be used only in conjunction with a pre-takeoff check.

De-icing/anti-icing fluids used during ground de-icing/anti-icing are not intented for - and do not provide - protection during flight.

Watching the HoT

- Do all the pilots know:
- How to interpret time windows, especially in changing weather?
- What kind of weather is Active Frost ?
  How does it differ from freezing fog for example?

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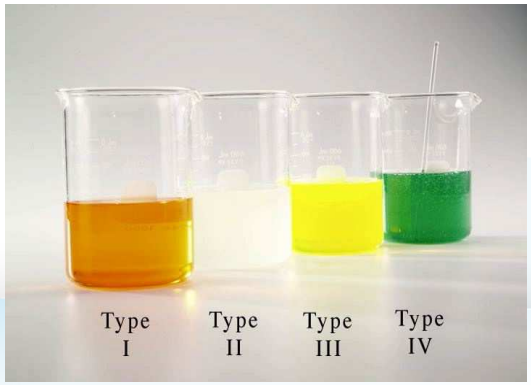
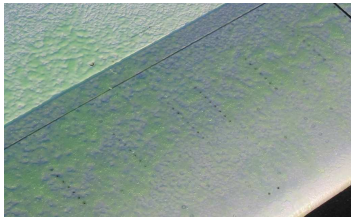
Actual Hold-over Time

FLUID PROPERTIES

- ✈ Fluid Thickness
- ✈ Fluid Temperature
- ✈ Glycol Percentage
- ✈ Glycol Type
- ✈ De-/Anti-ice Procedure



ENVIRONMENT



- ✈ Liquid Water Content -LWC
  +
- ✈ Droplet size =
  Precipitation type and rate
- ✈ Wing Temperature
- ✈ OAT
- ✈ Relative Humidity
- ✈ Wind
- ✈ Wing Surface Conditions

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Mental stress during departure

- Schedule
- Connections
- RWY closures
- Engine icing
- Running out of hold-over time
- Fuel remaining
- Wish to get out to the blue skies

- Need a re-treatment ???

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Contaminant Detectors

- With today´s technology presence of frost, ice, snow and even slush can be detected.

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A Detector could

- ✈Warn even if the flight crew forgets to check the wings
- ✈Confirm successful de-icing
- ✈Reduce stress during taxi
- ✈Warn if retreatment is required
- ✈Ensure safe takeoff

Why don´t we have Detectors?

- Manufacturers do not install them – Why?
- They do not exist – Why?
- Because airlines won´t buy them since they do not bring in any money
- There is no requirement for them in the regulations

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Difficulties in standardisation

- Contaminants are detectable, but…
- How to ensure that the detector will warn also when the true hold-over time runs out and proper flow off near lift off is jeopardised?

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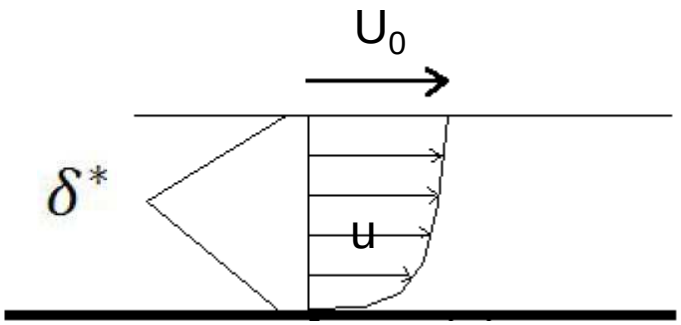
Aerodynamic Criteria for HoT

- Based on Boundary Layer Displacement Thickness

$$\delta^* = \int_0^\infty 1 - \frac{u}{U_0}\,dy$$



- u = Local air velocity
- U_0 = Free air velocity

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Boundary Layer Displacement Thickness

- Aerodynamic acceptance criteria for δ^* is about 8-9 mm depending on temperature (small reduction with temp. rise)
- Problem: Velocities can only be measured during takeoff run or in a wind tunnel
- Warning close to decision speed V_1 is too late!

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Thinking out of the box

- Define measurable criteria for fluid properties for the moment when lining up the runway for takeoff.

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In the mean time…

- ✈Understand & Respect the Phenomena
- ✈Fulfill present Standards
- ✈Ensure enough time for flight preparation
- ✈Ensure Aerodromes are up to the winter tasks

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ATM

- Should adjust quickly enough for sudden winter ops
- Minimise delays and offer shortest taxi-out times (those taxiing in are not as critical)
- CDM (Collaborative Decision Making) should take de-icings (gate or remote) into account.

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…to ensure the Clean Wing Concept

Thank You

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