Aircraft Surface Contamination Recurrent Training

Ground Icing

Air Law, The Clean Aircraft Concept

- **602.11 (1)** In this section, "critical surfaces" means the wings, control surfaces, rotors, propellers, horizontal stabilizers, vertical stabilizers or any other stabilizing surface of an aircraft and, in the case of an aircraft that has rear-mounted engines, includes the upper surface of its fuselage.

- **(2)** No person shall conduct or attempt to conduct a take-off in an aircraft that has frost, ice or snow adhering to any of its critical surfaces.

- **(3)** Notwithstanding subsection (2), a person may conduct a take-off in an aircraft that has frost adhering to the underside of its wings that is caused by cold-soaked fuel, if the take-off is conducted in accordance with the aircraft manufacturer's instructions for take-off under those conditions.

- **(4)** Where conditions are such that frost, ice or snow may reasonably be expected to adhere to the aircraft, no person shall conduct or attempt to conduct a take-off in an aircraft unless
- *(a)* for aircraft that are not operated under Subpart 5 of Part VII,
- (i) the aircraft has been inspected immediately prior to take-off to determine whether any frost, ice or snow is adhering to any of its critical surfaces, or
- (ii) the operator has established an aircraft inspection program in accordance with the *Operating and Flight Rules Standards*, and the dispatch and take-off of the aircraft are in accordance with that program; and
- *(b)* for aircraft that are operated under Subpart 5 of Part VII, the operator has established an aircraft inspection program in accordance with the *Operating and Flight Rules Standards*, and the dispatch and take-off of the aircraft are in accordance with that program.

- **(5)** The inspection referred to in subparagraph (4)(a)(i) shall be performed by
- *(a)* the pilot-in-command;
- *(b)* a flight crew member of the aircraft who is designated by the pilot-in-command; or
- *(c)* a person, other than a person referred to in paragraph (a) or (b), who
- (i) is designated by the operator of the aircraft, and
- (ii) has successfully completed an aircraft surface contamination training program pursuant to Subpart 4 or Part VII.
- **(6)** Where, before commencing take-off, a crew member of an aircraft observes that there is frost, ice or snow adhering to the wings of the aircraft, the crew member shall immediately report that observation to the pilot-in-command, and the pilot-in-command or a flight crew member designated by the pilot-in-command shall inspect the wings of the aircraft before take-off.
- **(7)** Before an aircraft is de-iced or anti-iced, the pilot-in-command of the aircraft shall ensure that the crew members and passengers are informed of the decision to do so.

- History has shown that numerous aircraft accidents have occurred due to contaminated critical surfaces from frost, ice or snow.
- Aircraft performance degradation is wide-ranging and unpredictable.
- Frozen contamination has two affects on aircraft by increasing the all-up-weight and reducing aircraft performance.
- The significance of these conditions led to the “Clean Aircraft Concept.”
- The Clean Aircraft Concept is essential to the maintenance of flight safety and the PIC has the ultimate responsibility to determine if the aircraft is in a condition for safe flight

- Canadian and Foreign Operators in Canada may take-off with hoar frost on the fuselage if the following conditions are met:
  - Hoar-frost shall be the only acceptable contaminant on the fuselage only, of aircraft with engines mounted on the rear fuselage.
  - Prior to conducting a takeoff, the operator shall ensure that the hoar-frost is not mixed with other contaminants such as ice or snow. If any other contaminant or contaminants are on the fuselage, the operator shall deice the entire fuselage.
  - A copy of this exemption shall be attached to the Aircraft Deicing/Anti-icing Procedures in the Operator's Manual

- Aircraft may be permitted to take-off with hoar frost on the fuselage of rear mounted engines or when cold soaked ice exists on the underside of the wing, if approved in the aircraft manufacturers instructions.

- It is everyone's responsibility to report contamination issues to the PIC immediately.

- The removal of the contaminants prior to flight operations is accomplished through the application of a heated deicing fluid that melts the ice and removes it from the aircraft. In addition, an ice-preventive agent (anti-icing fluid) may be applied to critical surfaces prior to take-off, to prevent the accumulation of ice on critical surfaces

Theory and Aircraft Performance

- A very small amount of frozen contamination as low as 0.40 mm (1/64 in.) disrupts the airflow over the lift and control surfaces of an aircraft and can result in severe lift loss, increased drag and impaired maneuverability.
- The adverse effect of frost, ice or snow on an aircraft decreases thrust and lift, increases drag and stall speed while altering handling qualities.
- Cold soaking can cause frost to form on the upper and lower wing under conditions of high relative humidity.
- Fueling an aircraft with cold fuel can cause cold-soaking. Ice can form even when the outside air temperature (OAT) is well above 0°C (32°F).

- Cold soaking can cause ice to form due to humidity in the air when there is no precipitation.

- Such ice is difficult to see and in many instances cannot be detected other than by touch with the bare hand or by means of a special purpose ice detector such as a Ground Ice Detection System (GIDS).

- A layer of slush on the wing cannot be assumed to flow off the wing on takeoff and must be removed. This layer can also hide a dangerous sheet of ice beneath.

- Sheets of clear ice dislodged from the wing or fuselage during takeoff or climb and can be ingested by aft fuselage mounted engines.

- Take-off may be made with frost adhering to the underside of the wings provided it is conducted in accordance with the **aircraft manufacturer's instructions**

- Aircraft anti-icing fluid Hold Over Times have not been evaluated under moderate and heavy freezing rain conditions or a heavy snowfall rate; therefore, these holdover times have not been generated.

- The holdover time performance of an anti-icing fluid in the presence of ice pellets has not been evaluated, but is expected to be extremely short.

- Evidence indicates that a visibility and temperature pair needs to be used for establishing more accurate snowfall rates.

- Holdover Time Guidelines represents their function in providing guidance to flight crew and the need for the flight crew to use judgment in their interpretation.

- GOFR 622.11 states in part: “When holdover timetables are used as decision-making criteria, only high confidence level times shall be used and the procedures to be followed after holdover time has expired must be clearly documented”.

De/Anti Icing Fluids

- Frozen contaminants are most often removed in commercial operations by using Freezing Point Depressant (FPD) fluids.
- It is the heat contained by the Type I (deice) fluid and hydraulic forces (high pressure spray equipment) that removes the frozen contaminants.
- It is imperative that take-off not be attempted on any aircraft unless the PIC has determined that all critical surfaces of the aircraft are free of frost, ice or snow contamination.
- Aircraft deicing/anti-icing fluids consist of four types. They are Type I, II, III, and IV.

- Deicing fluids are typically ethylene glycol, diethylene glycol or propylene glycol based fluids containing water, corrosion inhibitors, wetting agents and dye.

- Anti-icing fluids are similar in composition except that they also contain polymeric thickeners. They are formulated to prevent formation of unabsorbed frozen contamination for a longer period of time than deicing fluids; however, the protection is still for a limited period of time.

- The operator is ultimately responsible for ensuring that only qualified fluids are used.

- If the colour of the fluid being applied to the aircraft is NOT the colour anticipated, the procedure should be stopped and the situation investigated.

- Type I fluids are used for deicing or anti-icing, but provide **very** limited anti-icing protection.

- Type II fluids are designed to remain on the wings of an aircraft during ground operations, thereby providing anti-icing protection. This fluid should be used on aircraft with rotation speeds (Vr) above 100 knots, unless otherwise specified by the aircraft manufacturer.

- Type III fluids are designed for aircraft that have a shorter time to rotation and this should make it acceptable for some aircraft that have a Vr of less than 100 knots unless otherwise specified by the aircraft manufacturer.

- Type IV anti-icing fluids meet the same fluid specifications as the Type II fluids and have a significantly longer HOT.

- The LOUT for a given fluid is the *higher* of:
  - The lowest temperature at which the fluid meets the aerodynamic acceptance test for a given aircraft type, or
  - The actual freezing point of the fluid plus its freezing point buffer of 10°C, for a Type I fluid, and 7°C for a Type II or IV fluid.
- Some Type II or IV fluid residue may remain throughout the flight and this residue should be cleaned periodically. It is suggested that the use of heated Type I fluid/water high pressure washing may alleviate the occurrence of fluid dryout.

Preventative Measures and Deicing Procedures

- The best method of ensuring that an aircraft is clean of contamination is by preventing the contamination from collecting in the first place.
- Measures include hangers and wing covers.
- Manual methods to remove frozen contamination are brooms, brushes, ropes and scrapers.
- Heat from a portable forced air heater can effectively remove frost and ice from critical surfaces.
- Polishing frost is not considered an acceptable method of preparing an aircraft for flight.

- Proper fluid coverage is absolutely essential for proper fluid performance. It is imperative that the personnel applying the fluid are properly trained and that a consistent fluid application technique is utilized.

- An aircraft may be deiced by any suitable method such as hangering or manual methods.

- Deicing is normally accomplished using heated water or solutions of heated water and FPD fluids, often followed by anti-icing using cold, rich solutions that have a lower freezing point.

- Deicing and anti-icing with FPD fluids may be performed as a one-step or two-step process.

- For aerodynamic reasons, ensure that the deicing and anti-icing procedures are conducted in a symmetrical fashion.

- Generally, the fuselage should be de-iced and anti-iced from the top down.

- On many aircraft, deicing of the wing begins at the leading edge wing tip, sweeping in the aft and inboard direction. This procedure avoids increasing the snow load on outboard wing sections.

- For turbo-jet engines, FPD fluids should not be used for deicing internal components.

- Particular care should be exercised for the APU inlet because fluid ingestion could cause an APU runaway condition, flameout or, in an extreme case, an APU rotor burst which often results in a fire.

- Follow procedures to protect the aircraft during deicing/anti-icing with the main engines running.

- The Deicing Operator must routinely provide information to the pilot and advise of any problems or malfunctions.

- Critical surface inspections should be performed immediately after final application of the anti-icing fluid.

- As required by regulations, immediately prior to take-off, a pre-take-off inspection shall be made to determine whether frost, ice or snow is adhering to any of the aircraft critical surfaces, except where the operator has established a program in accordance with the **Ground Icing Operations Standards** and complies with that program.

- Take-off may occur after holdover time has been exceeded only if a pre-take-off contamination inspection is conducted and it is determined that critical surfaces are not contaminated.

Video