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Adapting To Winter Operations

Winter weather brings ice, snow and frost. All of these phenomena require specific piloting skills . The author has collected a number of tips to help wintertime operations proceed smoothly.

Pre-Flight and Engine Start

From a flight crew's view, an aerodynamically clean aircraft is important during cold-weather operations.

The captain is responsible for assuring that his aircraft is free of ice, snow or frost.

There is no set rule as to when ice removal/anti-ice procedures should be repeated. The only standard that can be applied is that an aircraft ready for service will not have snow or ice adhering to its surface and that its systems are capable of normal operations. Any reasonable doubt should be resolved in favor of returning to the gate/ramp for inspection and/or another de-icing.

Actuating and operating mechanisms can easily be frozen into a non-actuating or non-operating status, and ports and inlets can become clogged with ice and snow.

During walkaround, a thorough check of the aircraft should be made for accumulations of snow, ice, slush and even sand. Snow or ice impacted in the gear locks can cause erroneous gear indications. Flap surfaces should be inspected for possible damage caused during the previous landing and taxi operation.

The fueling process, depending upon the temperature of the fuel, can either melt ice or snow on wings or cause surface moisture to freeze. Dry snow that looks like it will blow off during takeoff may have an ice coating beneath it after being melted by "warm" fuel and then refrozen.

A coating of frost up to one-eighth of an inch thick is permissible on wing **lower surface only** in the area cold-soaked by fuel between the forward and aft spars.

Under extreme cold conditions, some flight instruments will be sluggish and give false information. Gyros may require more time to erect and align.

Cold, snow and ice accumulation can make aircraft systems react in unusual ways.

Engine inlets must be free of any ice or snow buildup before initiating a start. Engine fans (N1 rpm rotor) must be free to rotate; check that rpm before bringing in the fuel.

On three-engine equipment, any accumulation of snow or ice on the top of the fuselage must be removed to preclude ingestion. Snow or ice on fuselage upper surfaces of the twins can also slide back and affect stabilizer operation. Cold-soaked engines usually require more duct pressure to ensure a satisfactory start.

Expect engines to act differently in cold weather. Cold oil can cause abnormal oil pressures — allow time for temperatures to stabilize before increasing power. Cold constant-speed-drive oil will make the generator slow to develop steady power. Generator frequency should be allowed to stabilize before applying large electrical loads.

Consider the ramp condition before starting engines prior to push back. The aircraft could end up pushing the tow tractor instead of the tractor pushing the airplane.

Caution During Taxiing Out

Tires can freeze to the ramp. If the aircraft will not move under normal power, do not force it. The extra power can blow ice, snow and people around and possibly cause tire distortion and deflation. If a pilot has any trouble getting the aircraft to move, maintenance personnel should glycol the tire area.

Accumulations of snow and ice on ramps or holding areas may require greater than normal thrust to "break away" or maneuver an aircraft. Blast damage and the potential for injuries require added caution.

Taxi guidelines may be obscured by snow; ensure the aircraft is on the centerline. Parked aircraft may not be in proper position for the same reason, and wingtip clearance may be reduced.

Taxi with flaps up if taxi route is through slush or standing water in low temperatures. Do not accomplish Before Takeoff checklist until flaps are extended.

Taxi as if no brakes are available and as if nose steering is ineffective — taxi with care. Usually, runways get the most attention — ramps and taxiways the least.

Residual thrust produces faster taxiing speeds. More braking may be required, which could fade faster during a rejected takeoff.

Negotiating Ice Patches

It is not uncommon to have patches of ice on taxiways, ramps and runways when the precipitation has not accumulated sufficiently to call out the snow removal equipment and/or sanders. If possible, avoid stopping the aircraft with the nose gear on a patch of ice, especially if the surface has a high crown and the winds are gusty.

Sanded ramps and taxiways are a source of foreign object damage (FOD), so do not let aircraft in front blow FOD into your engines.

Prolonged ground operation increases exposure to accumulation of ice and snow after leaving the gate. Snow and slush blown by other aircraft can adhere to the aircraft. Maintain greater taxi separation than normal.

Prolonged taxi operations during adverse conditions is reason for extra crew alertness. Periodically, run up engines to a thrust setting as high as practicable to reduce the possibility of ice buildup on engine probes — have engine anti-ice **on**.

Do not use reverse thrust on snow or slush-covered ramps, taxiways or runways unless absolutely necessary. If reverse thrust is used during taxi, the airplane (especially the leading edges) must be carefully re-inspected for accumulation of snow, slush, ice or frost.

If it becomes necessary to increase power to obtain more effective anti-icing on the ground, is there adequate traction? Is there an aircraft behind?

Preparing for Takeoff

Verify that the aircraft still meets the snow/ice-free criterion before moving into takeoff position if accumulation conditions exist. Do not assume the snow will blow off during acceleration — and ice may be underneath the snow.

Slush and snow conditions have been known to change rapidly at times, placing considerable importance on up-to-date field condition reports. In addition to the effect on takeoff performance, "runway clutter," such as standing water, slush and snow, is also capable of producing airframe damage, even engine stalling or flameout.

Frost is probably the most deceptive form of icing. Its effect of decreasing the lift-drag ratio makes it an insidious takeoff hazard. It forms on exposed aircraft surfaces when skin temperatures are below freezing while surrounding air temperatures are above freezing.

Maximum depth for takeoff is one-half inch of water, slush or wet snow (one-quarter inch unless all conditions are favorable). Even this and smaller amounts will affect your takeoff performance. Takeoff corrections can be computed, but abort capabilities can only be surmised.

The use of reduced thrust procedures is prohibited on runways contaminated with snow, slush, standing water or ice. Engine monitoring during takeoff is especially important during cold weather operations — normal stable engine operation should be assured prior to takeoff — and monitor <u>all</u> parameters during takeoff.

Obtaining Optimum Directional Control

Directional control can be a problem during takeoff. Braking for control, until rudders become effective, can be particularly hazardous. A wheel that is locked and skidding on ice suddenly crossing a dry spot of runway can cause a tire to blow out or, worse, a violent swerve. If there is snow, slush or water on the runway, expect a longer takeoff roll.

Directional control during the takeoff roll on wet and slippery runway surfaces will be improved by holding the yoke forward to increase nosewheel traction. However, asymmetric thrust settings are probably going to have a more noticeable adverse effect on directional control. (It is worth noting that throttle alignment at partial power may not assure alignment at takeoff power).

A blob of snow on the nose may slide back onto the windshield about Vr and reduce forward visibility.

On takeoff, rotate smoothly and normally (not to exceed three degrees per second) at Vr . . . not before.

Tests have shown that one-sixteenth of an inch of ice on the **upper surface** wings produces a 30 percent increase in stalling speed. Wing flaps are less effective in reducing the stall. Airframe icing is rarely distributed evenly. One wing may stall before the other.

As a point of interest, it is recommended that the landing gear be raised in the normal manner following takeoff from a slush-covered runway. Delaying retraction to remove accumulations is described as ineffective.

Be prepared for a slight buffeting as flaps are retracted. If this occurs, it could mean there is ice on the wings. Reselect the previous flap setting and get some extra air speed before retracting the flaps.

Beware the Bird Hazard

Of course, winter takeoffs are not without their hazards, even on a dry runway. As the weather gets colder, many local birds are attracted by the warmth that radiates from runways after sunset. There may be other attractions on the airport, too, so be alert for the bird problem and report all sightings and strikes.

Review air-speed-error problems related to plugged pitot or static lines. A pilot should be able to takeoff, climb, cruise, descend and approach using the attitude indicator only. When the indicated attitude does not relate to the air speed, the pilot should be suspicious and fly attitude. Crosscheck power setting and other flight instruments.

Battling Ice Enroute

When icing is anticipated or encountered, immediately turn **on** anti-ice systems. Whenever engine anti-ice is turned **on**, turn **on** ignition system before turning the engine anti-ice **on**. Follow Pilot's Handbook procedures.

Wing and engine heat should be turned **on** prior to its requirement. Once turned **on**, do not turn **off** until the entire area is clear. Leading edge ice can melt, then run back a few inches and refreeze if the heat is turned **off** too soon. Voila! A natural spoiler. Avoid **selecting** engine anti-ice to more than one engine at a time when airborne, as it is much easier to relight one engine at a time.

Colder cruise temperatures are going to cause hydraulic quantities to show some cold-soaked shrinkage. Air conditioning units may need their controllable ram air doors closed in order to supply sufficient heat. Fuel icing conditions may show the need for more frequent use of fuel heat.

Precautionary Signals of CAT

Clear air turbulence (CAT) is a more common winter-month phenomenon. Jet streams and storm centers are more intense and will have moved further south than in the summer. High altitude winds need closer scrutiny. CAT is a wind shear at altitude.

Caution should be used when flying over mountainous terrain. Icing is more intense in clouds on the windward side and over crests of mountains on the leeward side. Strong winds, possible wind shears and icing conditions can be expected.

Tests indicate that severe icing is usually confined to an area 200 to 500 feet deep, so, when encountered, change altitude immediately.

Usually, ice crystals do not present an icing problem. However, incidents have been reported where, in ice crystals at -60 degrees C, the anti-icing heat raised the temperature to the icing range. Do not use in extreme cold temperatures.

Windshield icing increases the possibility of a mid-air collision. Remember, while one aircraft may have an ice-free windshield, how about the other airplane?

Heavy snow static occurs in cumulus clouds with an outside air temperature of five degrees C. Electrical charges of 450,000 volts have been reached. A change of air speed and altitude may be indicated.

Changes in Approach and Landing

During descent, the pilot must remember that the probability of encountering supercooled clouds at low altitudes, and the reduced aerodynamic heating at low air speeds, can contribute to an increased potential for ice accumulation. The probability of increased exposure time in holding patterns at high density airports can accentuate the problem.

The most severe clear icing conditions occur at temperatures between 0 degrees C and -10 degrees C in cumuliform clouds and freezing precipitation. At temperatures below -10 degrees C, either continuous ice or mixed rime and clear might occur. Weather frontal situations cause almost all of the severe icing conditions experienced in terminal areas.

Of particular note is the stratocumulus cloud layer which forms in a cold air mass that has moved over a warmer water surface. As the low levels of the air mass gain heat and moisture very rapidly, the stratocumulus cloud layer is formed. Icing is often moderate or severe in the tops of these clouds.

If airfoil anti-ice is used, turn it **off** before landing to cool the surfaces so that the snow does not stick to the leading edges or melt, run back and refreeze.

An Increase in Low-Visibility Approaches

Winter arrival usually produces an increased frequency of low-visibility approaches. The emphasis: early establishment of the prescribed "slot" conditions, i.e., the aircraft stabilized in the final landing condition at the proper descent rate, air speed appropriate to the existing conditions, steady-state thrust, zero stick force trim and proper runway alignment with no further maneuvering required.

The total crew concept, the sterile cockpit, established callouts, careful monitoring and crosschecks, clear cut go-around actions, one pilot on instruments to touchdown, etc., are designed to meet the challenges of the low-visibility approach and to preclude the problems of going in and out of visual contact or being trapped by visual illusions.

The effect of swirling snow can produce vertigo and also a "white out," in which ground and sky merge and become indistinguishable. The only reliable visual horizontal guidance then available will be obtainable from crossbar approach lights. If these do not exist, the effect can only be minimized initially by keeping the wings level as the critical height is approached so that any displacement from the runway centerline is readily recognized.

Instrument approach procedures have been formulated to facilitate the smoothest possible transition from instrument to visual flight, particularly under the lowest visibility minimums. Under such circumstances, it is essential to know the type of visual cues to be looked for and how much of the approach light system the pilot can expect to see after breakout. Angles play an important role here; i.e., glideslope angle, drift angle, angle of attack and the angle of over-the-nose visibility cutoff, with the latter dependent upon aircraft type and seat adjustment.

Proper Touchdown Technique

Landing on slippery runways introduces the challenge of decreased braking, hydroplaning, the greater effects of crosswinds and the reduced effectiveness of directional control. "In-the-slot" approaches become even more important. High, flat or fast approaches and long touchdowns are definitely to be avoided. Briefly summarized, the recommended techniques are:

- Land at minimum safe touchdown speed;
- Touchdown at the designated aiming point;
- A firm landing is better than a "grease job," which, under marginal conditions, could induce hydroplaning; and,
- Keep the nose wheel firmly on the runway.

Landing lights in heavy snow conditions may be ineffective and may reduce forward visibility.

Be alert for the effects of crosswinds and asymmetric thrust, especially if the aircraft is weather-cocked.

Smooth Braking

Once on the ground, put emphasis on early use of all means of stopping the aircraft. Deploy speed brakes as soon as possible after main gear touchdown and lower the nose wheel immediately. After wheel spinup, the anti-skid system is effective. Start a smooth, symmetrical brake application to control deceleration. Apply brakes smoothly, with moderate-to-firm pedal pressure, and hold the pressure. Pumping the brakes causes the anti-skid system to readjust brake pressure to reestablish optimum braking and lengthens the stopping distance.

Use as much runway for the rollout as needed to slow the aircraft, but keep in mind that friction on the "far" end of the runway is often severely reduced by fuel and rubber residues.

When landing on contaminated, icy runways, exercise good judgment and conservative operating practices. It should not be expected that all approaches and landings will be pressed to completion solely because minimums are met or because preceding aircraft have made it. Decisions to land or divert should be based on an objective analysis of the entire situation and the collective capability of the crew.

After landing, do not attempt to turn off the runway until speed is reduced to a prudent level. ♦

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