

## Chapter 6

### SERVICE AREA: Ground De-Icing and Anti-Icing

**1. Problem Description** Aircraft on the ground during periods of freezing or frozen precipitation and other icing conditions are susceptible to the buildup of ice on control surfaces, instrument orifices, propellers, and engine inlets and interiors. Aircraft that are moving along taxiway and runway surfaces in slush or standing water at near-freezing conditions are also susceptible to surface contamination, even after precipitation has stopped. Ice layers not removed from the wings and tail areas prior to takeoff can degrade lift and reduce the pilot's ability to climb, even to the point of stalling the wing and causing an uncommanded descent, pitch, or roll. Ice blockage of airspeed or altitude measurement instrumentation can cause loss of control or navigation errors.

Ground de-icing and anti-icing refers to the set of procedures and equipment required to remove and prevent the re-formation of hazardous levels of ice on aircraft surfaces prior to takeoff.

Ice and snow also have an impact on terminal operations. Boarding gates, taxiways, and runways may become unusable. Airport operational capacities may be sharply reduced. Operational procedures for clearing obstructions such as snowbanks may need to be invoked. The scope of this service area has been expanded to include these factors, since improved weather information can make the task of returning the terminal area to more normal levels of operations more efficient.

Some of the factors that can contribute to ice build-up on aircraft surfaces on the ground include:

- air temperatures,
- the type and rate of precipitation,
- wind speed,
- presence of standing water, slush, or windblown ice and snow,
- cold-soaked wings and fuel tanks, and
- the length of time the aircraft has been exposed to these conditions.

**2. Objectives** The goal of the ground de-icing and anti-icing service area is to eliminate instances of aircraft taking off with ice or snow contamination. To meet this goal, the National Aviation Weather Program establishes these objectives:

- reduction in the rate of ground icing-related accidents and incidents for all categories of aircraft, and,
- reduction in the delays and costs associated with ground de-icing/anti-icing operations for commercial aircraft.

**3. Decision Makers** The normal list of decision makers for aviation weather-related safety issues must be supplemented in this service area by three additional groups:

- air carrier ground crews and de-icing/anti-icing service vendors, who must know when and how to apply de-icing/anti-icing fluid to aircraft surfaces,
- de-icing/anti-icing vendors, who must allocate their personnel, equipment, and materials well ahead of the onset of actual conditions,
- airport operators, who must: 1) deploy employees and equipment to remove ice and snow from runways and taxiways and 2) be able to contain and dispose of used de-icing/anti-icing fluids.

Accurate and timely forecasts of ground icing conditions are critical so these groups can perform their functions properly and efficiently.

**4. Current Operations Concept** Pilots of all classes of aircraft are prohibited by regulation from taking off when their aircraft is contaminated by ice, frost, or snow buildup. In general, potential icing conditions at an airport are self-evident: snow or freezing rain is falling or the air temperature is close to freezing and standing water is present on aprons, taxiways, and runways. Ice, snowdrifts, and slush may also be present.

Standard practice calls for a pilot to make a visual inspection of the aircraft prior to takeoff. Regulations require that, during icing conditions, commercial airlines and air taxi/commuter operators perform a contamination check five minutes prior to takeoff; such a practice is strongly recommended for pilots of all other classes of aircraft as well. Some airports accommodate aircraft that can still develop frost or ice on critical surfaces due to cold-soaking at altitude (thus requiring de-icing) even though the airport itself does not experience ground icing conditions.

Because de-icing and anti-icing treatments are only effective for a limited time, pilots must be aware of how much time has passed since their application. The treatment effectiveness depends on many factors, including precipitation rate, type of precipitation, temperature, concentration of fluid, etc. Similarly, the pilot must be aware that the fluids exposed to the elements for extended periods may have become diluted and may not be effective in preventing icing as the aircraft moves toward the runway.

In all cases, the pilots have primary responsibility for ensuring the effectiveness of the de-icing treatment. If the pilot feels that the mitigation and prevention treatments either were not sufficient to eliminate the danger of ice or are no longer sufficient, the only safe decision is to delay the flight until fluids can be reapplied or until icing conditions abate.

Decisions brought on by ground icing are not just related to individual aircraft. Airport operations can also be severely hampered by ground icing. Runways may need clearing or may become impassable. Boarding gates may become unusable. Ground operations of all types may slow dramatically, causing delays and cancellations.

**5. Needed Service Improvements** Ground icing occurs in nearly every part of the country at some time during the year. Ice can be dangerous in areas where it is uncommon, since pilots and support personnel may be unfamiliar with the associated hazards. By the same token, ice can be dangerous in areas where it is a common occurrence, since pilots may tend to underestimate those same hazards. Improvements to the ground de-icing service area need to be made in several areas.

**5.1 Production of Weather Information.** All airports should have adequate observations

for the creation of products which provide a detailed local analysis of current icing conditions and pending changes. Data sampling rates should be increased during icing conditions in order to identify deteriorating conditions quickly. High-resolution, small-scale forecasts are required to make ground icing information as accurate as possible.



**5.2 Weather Product Generation and Delivery.** Observation, analysis, and forecast products relating to ground icing need to be disseminated rapidly to a wide audience, and these products need to be tailored to the varying

needs of the recipients. As usual, air traffic controllers, airline operations centers, traffic management personnel, and pilots need to receive timely and easily interpreted information so that needed changes in operating patterns can be quickly identified, planned and executed. These same products also need to be distributed to airport managers, airline station managers coordinating flights, and ground de-icing crews in order for them to perform their tasks with maximum effectiveness. The fact that the recipients are often within walking distance of each other does not preclude careful design of distribution systems to ensure delivery in even the most inclement conditions.

**5.3 Pilot Training.** Pilots are best able to cope with weather-related hazards when they understand and are familiar with the dangers they represent. Pilot training programs must be structured to emphasize the nature of the ground icing hazard and the need for vigilance on the part of pilots of all types of aircraft. Training must stress both the importance of taking off in a contamination-free aircraft and the proper use of weather data for understanding the potential hazard. Prevention of contamination must be the primary goal, but training in skills for dealing with an airborne aircraft with contaminated surfaces would also be valuable.

**6. Ground De-icing and Anti-icing Initiatives** On page 6-4 are the initiatives which have been identified for this service area.

Number	Ground De-Icing and Anti-Icing Initiatives	Relative Ranking*	Cooperating Organizations
1	Develop and implement ground de-icing decision aids which are applicable for use by pilots, ATC service providers, airline operations centers, and airport managers.	★★★★	FAA, NOAA/NWS, Industry**
2	Improve the detection and measurement of freezing/frozen precipitation, freezing fog, and frost to support ground de-icing, holdover, and airport operations.	★★★	NOAA/NWS, FAA
3	Develop and implement a training program on ground de-icing in order to increase air traffic controller, pilot, and ground crew awareness.	★★★	FAA
4	Enhance capabilities to rapidly disseminate freezing/frozen precipitation, freezing fog, and frost forecasts to ATC service providers, airport managers and operators, and airline operations centers in order to improve ground de-icing operations.	★★★	FAA, Industry
5	Develop/improve 0-2 hour forecasts of freezing/frozen precipitation, freezing fog, and frost in order to plan ground de-icing activities.	★★	NOAA/NWS, DoD, FAA
6	Develop/improve 2-6 hour forecasts of freezing/frozen precipitation, freezing fog, and frost in order to plan ground de-icing activities.	★	NOAA/NWS, DoD, FAA

\* The relative rankings assigned to the initiatives are based on a qualitatively calculated benefit/cost ratio. It's possible that a high-benefit initiative which is costly to implement may rank lower than a medium- or low-benefit initiative which is medium or low in cost to implement. All these initiatives are considered to have a positive benefit to aviation; however, when benefits and costs are considered, some rank relatively higher than others. Details can be provided upon request. Four stars (★★★★) is the highest ranking.

\*\* The term "Industry" in this context refers to private organizations (e.g., airlines, manufacturers, associations) which may represent both users and providers of weather information.