Advisory Circular

Subject: GROUND DEICING USING INFRARED ENERGY | **Date:** 12/13/05 | **AC No:** 120-89
Initiated by: AFS-220

1. PURPOSE. This advisory circular (AC) provides:

a. Guidelines and recommendations for pilots, certificate holders, and operators of deicing facilities regarding the use of infrared (IR) technology for deicing aircraft.

b. Industry best practices on the use of IR technology for deicing aircraft.

c. Guidance on the selection of an IR deicing facility as a means of deicing a certificate holder's aircraft.

d. Guidance on how to incorporate the use of IR technology into a certificate holder's approved deicing and anti-icing program.

e. An industry-wide means for obtaining approval for the use and inclusion of IR technology in an operator's Ground Deicing/Anti-Icing Program.

2. DEFINITIONS.

a. Anti-icing. A procedure used to provide protection against the formation of frost or ice and accumulation of snow or slush on clean surfaces of the aircraft for a limited period of time (holdover time (HOT)). Anti-icing fluids are normally applied unheated on clean aircraft surfaces, but may be applied heated, and include:

(1) SAE Type I fluid.

(2) Concentrates or mixtures of water and SAE Type I fluid.

(3) Concentrates or mixtures of water and SAE Type II fluid.

(4) Concentrates of SAE Type III fluid.

(5) Concentrates or mixtures of water and SAE Type IV fluid.

b. Deicing. A procedure used to remove frost, ice, slush, or snow from the aircraft in order to provide clean surfaces. The procedure can be accomplished using fluids, IR energy, mechanical means, or by heating the aircraft. Deicing fluid is usually applied heated to assure maximum deicing efficiency.

c. Frozen Contaminants. As used in this AC, frozen contaminants include light freezing rain, freezing rain, freezing drizzle, frost, ice, ice pellets, snow, snow grains, and slush.

d. Holdover Time (HOT). The estimated time that deicing/anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the critical surfaces of an aircraft. HOT begins when the final application of deicing/anti-icing fluid commences and expires when the deicing/anti-icing fluid loses its effectiveness.

e. Pretakeoff Check. A check of the aircraft's wings or representative aircraft surfaces for frozen contaminants. This check is conducted within the aircraft's HOT and **may** be made by observing representative surfaces from the flight deck, cabin, or outside the aircraft, depending on the type of aircraft and operator's FAA-approved program.

f. Pretakeoff Contamination Check. A check (conducted after the aircraft's HOT has been exceeded) to ensure the aircraft's wings, control surfaces, and other critical surfaces, as defined in the certificate holder's program, are free of all frozen contaminants. This check must be completed within 5 minutes before beginning takeoff and from outside the aircraft, unless the certificate holder's FAA-approved program specifies otherwise.

g. Post-Deicing Check. A check, after deicing application, to ensure that all aircraft critical surfaces are free of frozen contaminants.

3. RELATED READING MATERIAL. The following material is useful as further guidance and in developing training program subject material and instructions, and procedures for incorporation in the certificate holder's manuals and/or deicing/anti-icing program:

a. U.S. Government Publications.

(1) AC 120-60, Ground Deicing and Anti-icing Programs, as amended.

(2) The annual Flight Standards Information Bulletin (FSAT) on ground deicing.

(3) AC 150/5300-14, Design of Aircraft Deicing Facilities, Change 2

NOTE: ACs are located on the FAA web site at http://www.airweb.faa.gov/rgl. The FSAT is located on the FAA web site at http://www.faa.gov/library/manuals/examniners_inspectors/8400/fsat

b. Publications of the Society of Automotive Engineers (SAE). Copies of the following documents may be obtained by writing to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096-0001.

(1) Aerospace Materials Specification (AMS) 1424, Deicing/Anti-Icing, Fluid, Aircraft, SAE Type I.

(2) Aerospace Materials Specification (AMS) 1428, Deicing/Anti-Icing, Fluid, Aircraft, Non-Newtonian, Pseudo-Plastic, SAE Type II, III & IV.

(3) Aerospace Recommended Practice (ARP) 4737, Aircraft Deicing/Anti-Icing Methods.

(4) Aerospace Recommended Practice (ARP) 5149, Training Program Guidelines for Deicing/Anti-icing of Aircraft on Ground.

c. Publications of the International Standards Organization (ISO). Copies of the following documents may be obtained from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY, 10036, (212) 642-4900.

(1) ISO 11075, Aerospace-Aircraft Deicing/Anti-Icing Newtonian Fluids ISO Type I.

(2) ISO 11076, Aerospace-Aircraft Deicing/Anti-Icing Methods with Fluids.

(3) ISO 11078, Aerospace-Aircraft Deicing/Anti-Icing Non-Newtonian Fluids ISO Type II.

d. Publications of the Association of European Airlines (AEA). AEA Recommendations for Deicing/Anti-icing of Aircraft on the Ground. This publication can be found on the following web site: http://www.aea.be. Select "publications" then click on "deicing/anti-icing."

e. Safety Studies.

(1) American Gas Association (AGA) Research Bulletin #92, November, 1962.

(2) Ocular Effects of Radiation, D. Cogan, AMA Archives of Industrial Health, Vol. 20, #4, Pg 293-296, 1959.

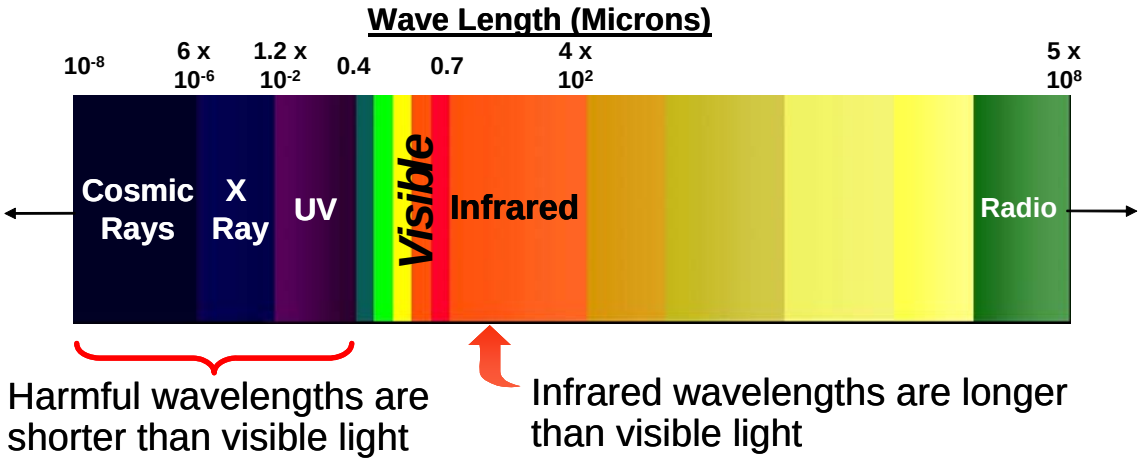
(3) Basic Principles of Ventilation and Heating, T. Bedford, et. al., H.K. Lewis Company, Ltd., 1948.

4. BACKGROUND. Given the cost of deicing with conventional fluids and the recent demand for alternative deicing methods interest in IR deicing systems has increased. IR energy has been used by the industrial and domestic heating industry for several decades. Studies (see paragraph 3e) have shown that, when used properly, IR energy has no harmful effects on humans or animals. Federal Aviation Administration (FAA) tests, conducted under a Cooperative Research and Development Agreement (CRDA), have also demonstrated that IR energy does not pass through the aircraft surfaces and has a negligible effect on cabin internal temperature. The FAA encourages the development and use of alternative methods of deicing such as IR systems.

However, as with all ground deicing equipment, it is necessary to ensure that IR deicing systems are used with the highest degree of competence and safety. Consequently, the FAA has developed the general safety criteria in this AC for certificate holders to use to evaluate IR deicing systems for use in a certificate holder's approved deice/anti-ice program.

5. DISCUSSION. IR energy can be produced in a number of ways. The method most commonly used for deicing is a gas-fired IR system. This system uses gas-fired units suspended from the ceiling of the modular shelter facility. These units are controlled by an on-site operator located at a control station within the facility. The system can be instantly turned off using emergency shutdown buttons located either at the control station or around the facility. This system has been used to deice commuter and moderate sized (e.g., B-757) aircraft. As of the publication date of this AC, a system capable of deicing large aircraft (e.g., B-747) is being installed at a major U.S. international airport.

a. The following graphic illustrates the location of IR wavelengths within the electromagnetic spectrum.



b. Unlike heated hangars where convection heat energy is generally distributed, IR energy does not heat the air that it passes through. The energy is concentrated on specific areas. When deicing, the IR emitter units impart sufficient IR focused energy on the aircraft surfaces in line-of-sight of the IR units to melt the frozen contaminants on those surfaces. If the energy does not reach the underbody of the aircraft including the landing gear, ice could be retained at these locations even though the upper parts of the aircraft are free of ice contamination. In situations where the underbody is clean it could be possible, under certain conditions, for water to refreeze on parts of the underbody as it runs off of the wing and other upper portions of the aircraft. However, heat always seeks a balance with surrounding areas and always moves from the warmer medium to the cooler medium. In-service experience has demonstrated that some of the heat energy reflected by the facility structure, in addition to the heat energy which is absorbed by the ground before the aircraft arrives, will re-radiate to the colder under-wing and landing gear surfaces to remove frozen contamination. **As with all deicing methods, post-deicing inspection of these areas is required to ensure that all frozen contamination has been removed.**

c. Deicing fluid can be used in conjunction with IR energy in cases where water refreezes on parts of the airplane not exposed to IR energy. Anti-icing fluids may also be used if the deiced airplane is expected to operate in active ground icing conditions. HOT may be used with the application of anti-ice fluid. However, no HOT exists for IR energy.

d. Using IR energy to deice airplanes can be part of any certificate holder's deicing/anti-icing program/plan regardless of whether the certificate holder is operating under part 121, 125, or 135. Since IR facilities are not certificated, a certificate holder who wishes to use an IR facility should confirm that the IR facility meets the criteria of this AC, with supporting documentation, before including that IR facility in its program/plan.

e. When an IR facility is used, it remains the responsibility of flightcrews to assure that all contamination has been removed from the aircraft and that no further contamination is likely to occur before take off. If contamination is likely to occur after IR deicing and the facility includes the application of an anti-ice freezing point depressant (FPD), the IR facility operator's use of the FPD must comply with the requirements of section 121.629(c).

6. APPROVAL CRITERIA. A certificate holder wishing to use an IR deicing facility should ensure that the IR deicing system used by that facility meets the criteria presented in this AC or provide an alternative, acceptable means of assuring the operational safety of the deicing facility.

a. Certificate holders should use the following criteria for approving the use of IR deicing systems:

(1) The IR facility operator should provide an appropriate description of the system (hardware, energy source, markings, etc.).

(2) The IR deicing system should perform its intended purpose, i.e., it must be capable of effectively deicing an aircraft.

(3) The IR deicing systems should not create a hazard to:

(a) Aircraft.

(b) Ground personnel.

(c) Crewmembers.

(d) Passengers.

(e) Cargo.

(f) Airport facilities.

i. IR energy has no effect on navigational aids, antennas, communication facilities, and buildings as it is in a very different area of the electromagnetic spectrum (see

graphic on page 3). However, the system location (as with any airport structure) should be approved with regards to tower sightlines and runway obstacle free areas, etc. This is normally accomplished by the local airport authority in their applications to the FAA.

ii. The FAA requires that IR aircraft ground deicing facilities are designed to operate with the IR energy source positioned at least ten feet away from the aircraft surface.

(4) Any IR system for approval should be in general agreement with appropriate industry standards, as created by groups such as the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO), and should conform to applicable FAA documents listed in paragraph 3, Related Reading Material.

(5) Any process for approving the operational use of an IR system should follow established guidelines set by industry groups, such as SAE, ISO, Air Transport Association (ATA), International Civil Aviation Organization (ICAO), and the General Aviation Manufacturing Association (GAMA). These guidelines should address:

(a) The training of flightcrew, IR equipment ground operator personnel, facility maintenance personnel, and anti-icing ground personnel.

(b) Melted ice flowing into aerodynamically quiet areas and refreezing (SAE ARP4737).

(c) Additional deicing and anti-icing requirements.

(d) Environmental considerations.

(6) Notification must be obtained from the aircraft manufacturer that IR energy can safely be used on composite aircraft surfaces.

b. Once a certificate holder has determined that the IR deicing system to be used by a deicing facility meets these criteria, the certificate holder should present its findings to the FAA for review. Once the FAA determines from the findings presented that the IR deicing system does meet all criteria, the system may become part of the certificate holder's deicing/anti-icing program.

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