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Aircraft Inflight Icing Terminology

1. SCOPE:

This SAE Aerospace Information Report (AIR) provides definitions for terms commonly used in aircraft inflight icing system design and analysis, research, and operations. Some general thermodynamic terms are included that are frequently used in icing analysis, but this document is not meant to be an inclusive list of such terms.

1.1 Purpose:

The purpose of this document is to provide an assemblage of definitions for terms commonly used in aircraft icing. Over time, the field of aircraft icing has evolved a set of terms that are sometimes used in different ways and have different meanings. This document is a compendium of icing terms and their associated definitions.

The SAE does not endorse or recommend any particular definition given in this report.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the referencing document. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP147	Environmental Control System (ECS) Terminology
AIR1168/4	Aerospace Applied Thermodynamics Manual; Ice, Rain, Fog, and Frost Protection.
AIR1667	Rotor Blade Electrothermal Ice Protection Design Considerations
AIR4367	SAE Aircraft Ice Detectors and Icing Rate Measuring Instruments
AS5498	Minimum Operational Performance Specification For Inflight Icing Detectors (also EUROCAE ED-103)

2.1.2 Federal Aviation Administration Publications: Available from FAA, 800 Independence Avenue SW, Washington, DC 20591.

14 CFR Part 1	Title 14 of the US Code of Federal Regulations, Part 1, Definitions and Abbreviations
14 CFR Part 23	Title 14 of the US Code of Federal Regulations, Part 23, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes
14 CFR Part 25	Title 14 of the US Code of Federal Regulations, Part 25, Airworthiness Standards: Transport Category Airplanes
14 CFR Part 29	Title 14 of the US Code of Federal Regulations, Part 29, Airworthiness Standards: Transport Category Rotorcraft
-------	Aeronautical Information Manual, October 1996
-------	U.S. Standard Atmosphere, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration and United States Air Force
AC 20-73	Aircraft Ice Protection
AC 29-2C	Certification of Transport Category Rotorcraft
ADS-4	Engineering Summary of Airframe Icing Technical Data, FAA Technical Report, March 1964.
DOT/FAA/CT -88/8	Aircraft Icing Handbook, Volumes 1, 2 and 3, March 1991 and subsequent revisions
DOT/FAA/ARI -96/81	Proc. of the FAA International Conference on Aircraft Inflight Icing, August 1996

2.1.3 Other Publications:

Aeronautical Information Manual, October 1996

AGARD Icing Testing for Aircraft Engines, August 1978

Forecasters' Guide on Aircraft Icing, Air Weather Service Report No. AWS/TR-80/001, March 1980

Glossary of Meteorology, American Meteorological Society, 2000

International Meteorological Vocabulary – Second Edition, WMO/OMM/BMO – No. 182, 1992

Jane's Aerospace Dictionary, First Edition, 1980, Jane's Publishing Incorporated, 730 Fifth Avenue, New York, NY 10019

The Development of an Advanced Anti-icing/Deicing Capability for U. S. Army Helicopters, Volume I – Design Criteria and Technology Considerations, U.S. Army Report Number USAAMRDL-TR-75-34B, Nov. 1975

3. GENERAL DISCUSSION:

There are many sources of definitions for inflight aircraft icing terminology, but these terms have not been consolidated into a single reference document. In many cases the terms are not used in the same way, causing confusion in their use. While this document is intended to be used primarily by icing research and development engineers and certification authorities, it provides the definitions of icing terms helpful to personnel involved with other facets of icing technology. The definitions provided herein are intended to provide a description of icing terms and their usage so as to promote clarity during discussions of aircraft icing issues. A word shown in capital letters in a definition refers to terms defined in the document, but not all defined terms are capitalized, such as the words "ice," "airplane," and "system." The sources of definitions that appear in other published documents of a regulatory or specification nature are noted in parenthesis immediately following the associated definition and are identified as follows:

AGARD	AGARD Icing Testing for Aircraft Engines, "Meteorological Icing Conditions", August 1978
ADS-4	Definition from Engineering Summary of Airframe Icing Technical Data, FAA Technical Report, March 1964
AIM	Aeronautical Information Manual, October 10, 1996
AS5498	Definition from the EUROCAE WG54 Minimum Operational Performance Specification For Inflight Ice Detectors (ED-103 and AS5498)
FAA29-2	Definition from 14 CFR 29 Advisory Circular 2C
FAACII	Proceedings of the FAA International Conference on Aircraft Inflight Icing, DOT/FAA/AR-96/81,V. I, August 1996, p. 193
FAAIH	Definition from FAA Aircraft Icing Handbook (DOT/FAA/CT-88/8)
FG	Forecaster's Guide on Aircraft Icing, March 1980

3. (Continued):

GM	Glossary of Meteorology, 2000
Jane's	Jane's Aerospace Dictionary, 1980
SAE1168	SAE Aerospace Applied Thermodynamics Manual (AIR1168)
SAE147	SAE Environmental Control System (ECS) Terminology (ARP147)
SAE1667	SAE Rotor Blade Electrothermal Ice Protection Design Considerations (AIR1667)
SAE4367	SAE Aircraft Ice Detectors and Icing Rate Measuring Instruments (AIR4367)
USAAMRDL	U.S. Army Report Number USAAMRDL-TR-75-34A, "The Development of an Advanced Anti-icing/Deicing Capability for U.S. Army Helicopters, Volume I – Design Criteria and Technology Considerations", Nov. 1975. p. 40-44
WMO	International Meteorological Vocabulary, 1992

Note that the definitions from these sources may be modified to add alternative units. The source(s) of terms that have broad acceptance are not specifically identified.

Many of the terms have multiple definitions, much in the same manner found in a dictionary. Different definitions are numbered. Also, definitions from different sources are numbered, even though the definitions may be very similar. The order of the definitions for terms with multiple definitions does not indicate a preferred order.

An SAE recommended definitions document is planned. When published, it will replace this document.

Definitions proposed by the FAA Working Group 1B as a revision to 14 CFR 1 are not included in this document since they are still under review.

4. LIST OF AIRCRAFT INFLIGHT ICING TERMS AND ABBRIEVIATIONS:

ACCRETION: See ICE ACCRETION.

ADHESION BOND STRENGTH: A measure of the degree of adhesion between ICE and a surface (substrate) to which it is attached (or bonded). The degree of adhesion is usually measured in a simple lap shear adhesion test (although tensile adhesion normal to the substrate interface is also an important consideration). The degree of adhesion is expressed in force (e.g., pounds) per unit area (e.g., square inches). Temperature, substrate material, and surface conditions at the ice/substrate interface are important factors to consider when measuring adhesion bond strength.

ADIABATIC EXPANSION: A process in which no heat is transferred and the mass has a decrease in temperature (FAAIH).

ADIABATIC LIFTING THEORY: Method of calculating LIQUID WATER CONTENT by the adiabatic cooling process (and associated condensation of water droplets) as a mass of air rises (ADS-4).

4. (Continued):

ADIABATIC PROCESS: (1) A process in which a state change is accomplished on or in a fluid without heat transfer to or from the surroundings (ARP147). (2) A process in which a system does not interact with its surroundings by virtue of a temperature difference between them. In an adiabatic process any change in internal energy (for a system of fixed mass) is solely a consequence of working. For an ideal gas and for most atmospheric systems, compression results in warming, expansion results in cooling (GM). (3) A thermodynamic change of state of a system in which there is no transfer of heat across the boundaries of the system. In an adiabatic process, compression always results in heating, expansion in cooling.

ADVISORY FIDS: (1) A FIDS that provides the cockpit crew with an additional indication of ICE or icing, but the cockpit crew still activates ICE PROTECTION SYSTEMs based on Aeroplane Flight Manual (AFM) criteria (typically when the total air temperature is below a threshold level and visible moisture is present) and not solely based on the FIDS (AS5498). (2) A device that enunciates the presence of ICING CONDITIONS.

AERODYNAMIC PERFORMANCE MONITORING SYSTEM: An aerodynamic performance monitoring system informs the cockpit crew or another system about degradation of aerodynamic performance (AS5498). See also ICING SEVERITY DETECTION AND INDICATION SYSTEM.

AGL: Above ground level.

AIR: Aerospace Information Report

AIRMASS: A widespread body of air, the properties of which can be identified as having been established while that air was situated over a particular region of the earth's surface, and undergoing specific modifications while in transit away from the source region (FAAIH, GM).

AIR, STANDARD SEA LEVEL: See STANDARD SEA LEVEL AIR.

ALTITUDE, PRESSURE: See PRESSURE ALTITUDE.

ALTITUDE, STANDARD: See STANDARD ALTITUDE.

ALTOCUMULUS (Ac): (1) A principal cloud type, white and/or gray in color, that occurs as a layer or patch with a waved aspect, the elements of which appear as laminae, rounded masses, rolls, etc. (GM). (2) White or grey, or both white and grey patch, sheet or layer of cloud, generally with shading, composed of laminae, rounded masses, rolls, etc, which are sometimes partly fibrous or diffuse and which may or may not be merged; most of the regularly arranged small elements usually have an apparent width of between one and five degrees (WMO). (3) A mid-level (6500 to 20,000 ft) CUMULIFORM cloud, appearing white or gray colored and as laminae, rounded masses, or rolls with some turbulence and small amounts of icing.

4. (Continued):

ALTOSTRATUS (As): (1) A mid-level (6500 to 20,000 ft) STRATIFORM cloud appearing either as a gray or bluish (never white) sheet or layer with a striated, fibrous, or uniform appearance; may totally cover the sky and extend over an area of several thousand square miles with a VERTICAL EXTENT from several hundred to thousands of feet (FAAIH). (2) A principal cloud type in the form of a gray or bluish (never white) sheet or layer with a striated, fibrous, or uniform appearance (GM). (3) Greyish or bluish cloud sheet or layer of striated, fibrous or uniform appearance, totally or partly covering the sky, and having parts thin enough to reveal the Sun at least vaguely, as through ground glass. Altostratus does not show halo phenomena (WMO).

AMBIENT TEMPERATURE: (1) The STATIC TEMPERATURE of the medium surrounding any unit under consideration (ARP147). (2) The temperature that is characteristic of the atmosphere surrounding a small-scale feature such as a cumulus cloud (GM).

ANTI-ICE VALVE: A control valve, often a regulator and shutoff type, which supplies hot air to the wing or nacelle ANTI-ICING systems. Sometimes it is part of, or specified with ECS components, or sometimes it is part of, or specified with BLEED AIR components (ARP147).

ANTI-ICING, ANTI-ICE: (1) Prevention of ICE from forming on aircraft surfaces (FAAIH). (2) The prevention of ice formation on a surface. (AS5498, ARP147). (3) The prevention of ice or accumulation on a protected surface either by evaporating the impinging water or by allowing it to run back and off the surface or freeze on non-critical areas (AIR1168/4). (4) The prevention of ice formation on airframe surfaces (ADS-4).

APPENDIX C ICING CONDITIONS: Conditions for ICE protection certification found in Appendix C of CFR 14 Part 25 or Part 29. The MED is less than 50 microns; the maximum droplet diameter is less than 135 microns for a Langmuir E droplet distribution.

APMS: Aerodynamic Performance Monitoring System (AS5498).

ARP: SAE Aerospace Recommended Practice.

ARTIFICIAL ICE: (1) Real ICE, but formed by artificial means, such as a spray rig in a tunnel or on a tanker (AIR1667). (2) ICE SHAPEs that are fabricated from wood, epoxy, or other materials (See SIMULATED ICE).

ARTIFICIAL ICING: The process of creating ARTIFICIAL ICE, i.e., creating aircraft icing via the use of an icing tunnel or icing tanker.

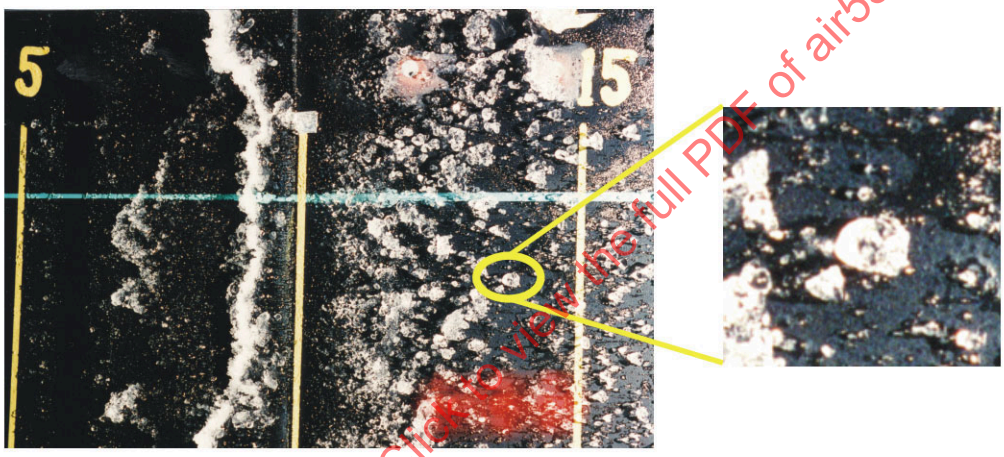
AS: SAE Aerospace Standard

ATMOSPHERE, STANDARD: See STANDARD ATMOSPHERE.

4. (Continued):

AUTOMATIC CONTROL: A device or system of devices which autonomously regulates some parameter or output to a reference parameter. Used to automatically modify system operation to drive output performance to a desired value or criteria (ARP147).

BEAD: A freestanding, non-uniform, rounded ICE SHAPE formed away from the main ICE ACCRETION.



Bead

FIGURE 1 - Bead

BEAK ICE: (1) ICE ACCRETION formed near the suction peak of the clean airfoil when the freestream TOTAL TEMPERATURE is above freezing. Predominately seen on rotor blades. (2) Ice accretion resembling a bird's beak, formed near the suction peak of the clean airfoil when the freestream total temperature is above freezing. Predominately seen on rotor blades, since the total temperature varies along the rotor blade span.

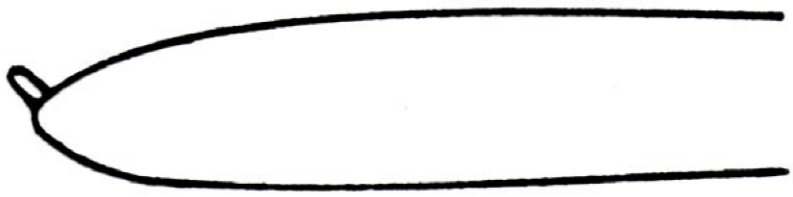


FIGURE 2 - Beak Ice Sketch

4. (Continued):

BIODEGRADABLE: The ability of a substance, when exposed to a natural outdoor environment, to spontaneously break down chemically into compounds which have no harmful environmental effects (FAAIH).

BLEED AIR: (1) Small extraction of hot air from a turbine engine compressor (FAAIH). (2) A relatively small amount of air diverted to an auxiliary use (FAAIH). (3) Air bled from the compressor of a gas turbine engine (ARP147).

BLOWOFF: Water which "blows off" a body that is exposed to airflow. In the context of icing, blowoff is the portion of water that does not freeze upon impact or RUNBACK, and does not evaporate from the body surface. The portion of water which blows off is a function of the icing condition, body GEOMETRY and body surface temperature.

BOOT RIDGE: ICE that remains on an airfoil aft of the active area of a PNEUMATIC DEICER system, after the deicer system has been activated. One way this occurs is when ice has accreted on the airfoil over a larger area than that covered by the DEICING system (see ICE RIDGE).

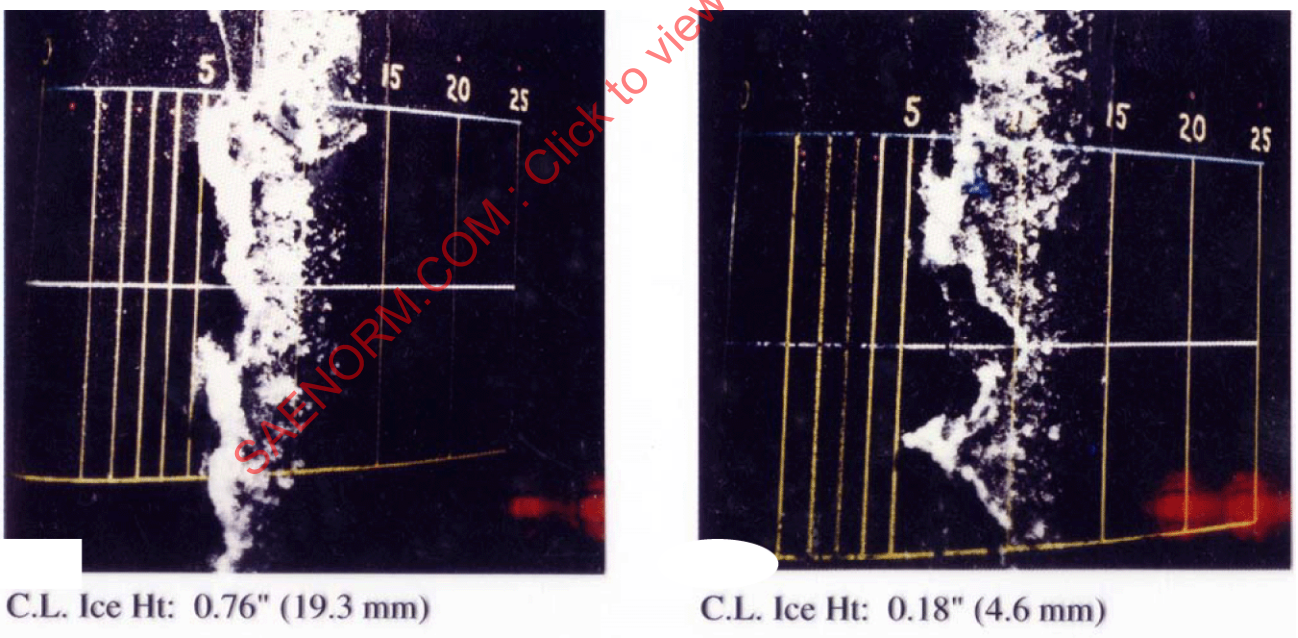


FIGURE 3 - Boot Ridges

4. (Continued):

BRIDGING: (1) The formation of an arch of ICE over a PNEUMATIC BOOT on an airfoil surface (FAAIH). (2) The formation of an arch of ice over the boot which is not removed by inflation. (FAAIH). (3) Classic ice bridging occurs over a pneumatic boot tube when a thin layer of ice is sufficiently plastic to deform to the shape of the inflated boot tube without being fractured or shed during the ensuing tube deflation. (4) A term also used to describe the connection of ice between a deiced and non-deiced region (see PARTING STRIP).

BUMPS: Part of GLAZE ICE formations that show a non-uniform rounded shape. They may be covered by ROUGHNESS ELEMENTS.

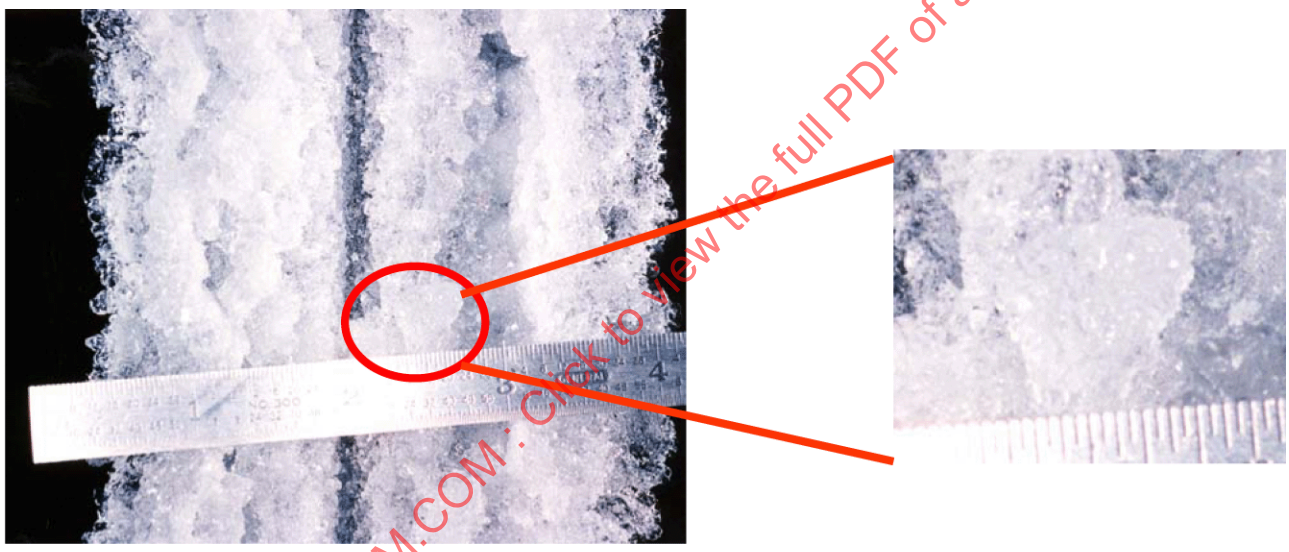


FIGURE 4 - Bump (scale in inches)

CAPACITOR: A storage device for electrical energy consisting essentially of two conducting surfaces separated by an insulating material. A capacitor blocks the flow of direct current and effectively permits the flow of alternating current (FAAIH).

CFR: Code of Federal Regulations.

CHARACTERISTIC LENGTH: A characteristic length for a given problem is a convenient length, such as the chord of an airfoil, used to specify the geometric scale of the problem (FAAIH).

4. (Continued):

CIRROCUMULUS (Cc): (1) A principal cloud type appearing as a thin, white patch of cloud without shadows composed of very small elements in the form of grains, ripples, etc. (GM). (2) Thin, white patch, sheet or layer of cloud without shading, composed of very small elements in the form of grains, ripples, etc, merged or separated, and more or less regularly arranged; most of the elements have an apparent width of less than one degree (WMO). (3) A high level (20,000 to 30,000 ft) thin, CUMULIFORM cloud appearing as a white patch of cloud without shadows, composed of very small elements in the form of waves or ripples. Usually ICE CRYSTALS, but may contain highly SUPERCOOLED WATER DROPLETS. Some turbulence and potential for icing.

CIRROSTRATUS (Cs): (1) A high level (20,000 to 30,000 ft) STRATIFORM ice-crystal cloud appearing as a whitish veil or sheet usually fibrous but can be smooth. Often totally covers the sky. Often produces halo phenomenon. No turbulence and little, if any, potential for icing (FAAIH). (2) A principal cloud type appearing as a whitish veil, usually fibrous but sometimes smooth, that may totally cover the sky, and that often produces halo phenomena, either partial or complete (GM). (3) Transparent, whitish cloud veil of fibrous (hair-like) or smooth appearance, totally or partially covering the sky and generally producing halo phenomena (WMO).

CIRRUS (Ci): (1) A high level (20,000 to 30,000 ft) thin, STRATIFORM ice crystal cloud. Larger ICE CRYSTALS often trail downward in wisps called "mare's tails." Detached cirriform elements in the form of feather-like white patches or narrow bands have little turbulence or potential for icing. Dense bands, however, contain turbulence (FAAIH). (2) A principal cloud type composed of detached cirriform elements in the form of white, delicate filaments, of white (or mostly white) patches, or of narrow bands (GM). (3) Detached clouds in the form of white, delicate filaments or while or mostly while patches or narrow bands. These clouds have a fibrous (hair-like) appearance, or a silky sheet, or both (WMO).

4. (Continued):

CLEAR ICE: (1) A glossy, clear, or translucent ICE formed by the relatively slow freezing of large SUPERCOOLED WATER DROPLETS (AIM). (2) A glossy, clear, or translucent ice formed by the relatively slow freezing of large supercooled droplets. The large droplets spread out over the airfoil before complete freezing, forming a sheet of clear ice (FG). (3) A glossy, clear, or translucent ice formed by relatively slow freezing of large supercooled water droplets. The large droplets spread out over the airfoil prior to complete freezing, forming a sheet of clear ice. Although clear ice is expected mostly with temperatures between 0 °C (32 °F) and -10 °C (14 °F), it does occur at temperatures as cold as -25 °C (-13 °F) (FAAIH). (4) Transparent ice formed during flight in clouds by the slower freezing of supercooled water droplets. This is most likely to occur at AMBIENT TEMPERATUREs near freezing when the droplets may flow along the surface or remain liquid before freezing occurs. The ice formed during FREEZING RAIN is also an example of clear or GLAZE ICE. This type of ice may occur at conditions above the LUDLAM LIMIT, reducing the apparent LWC. (See also GLAZE ICE) (AIR1667). (5) Smooth compact rime, usually transparent, fairly amorphous, with a ragged surface, and morphologically resembling glaze. This term has two different major applications: (a) most commonly, it is used as a synonym for glaze, particularly with respect to aircraft icing. Factors that favor clear ice (or glaze) formation are large drop size, rapid accretion of liquid water, slight supercooling, and slow dissipation of latent heat of fusion. Thus, an aircraft flight through supercooled rain at an air temperature of 0 to -4 °C is most conducive to clear icing. This type of icing does not seriously distort airfoil shape, but it does add appreciably to the weight of the craft. (b) The term may also be applied to homogeneous bodies of glacier ice and lake ice (GM). (6) Smooth, compact rime, usually transparent, fairly amorphous, with a ragged surface, and morphologically resembling glaze (WMO). (7) Transparent ice that is conformal to the surface.

COLD SOAK: A condition where an object has cooled to a low temperature over a prolonged period of time. In the context of aircraft icing, this term is often applied to the condition where the fuel has reached a subfreezing temperature due to prolonged exposure at cold temperatures. Upon landing at a humid location, condensation can occur on the cold external surfaces of the wing fuel tanks and create a layer of ICE that can reduce lift or cause damage due to ice SHEDDING.

COLLECTION EFFICIENCY: (1) The ratio of actual water collection rate to the water catch rate when water droplet paths are straight lines (ADS-4). (2) In cloud physics, for aerodynamically interacting cloud and precipitation particles: (a) for interacting water drops, the product of COLLISION EFFICIENCY and coalescence efficiency; (b) for interacting ice particles, or for water droplets interacting with ice particles, the product of collision efficiency and adhesion efficiency. Same as WATER CATCH EFFICIENCY (GM). (3) The ratio of actual water droplet FLUX (water collection rate) at the surface to the water droplet FLUX in the freestream when water droplet paths are straight lines (AIR1667). See also WATER CATCH EFFICIENCY.

COLLISION EFFICIENCY: In a cloud, the probability that a larger drop will collide with a smaller one in its direct path.

COMPUTED ICING: ICE SHAPEs that are generated from computational fluid dynamics (CFD) tools.

4. (Continued):

CONDITIONAL INSTABILITY: (1) The state of a column of air in the atmosphere when its temperature lapse rate is less than the DRY ADIABATIC LAPSE RATE, but greater than the SATURATION ADIABATIC LAPSE RATE (FAAIH, GM). (2) Type of static instability that exists at a specific point in the atmosphere only if the air is saturated (WMO).

CONDUCTIVITY, THERMAL: See THERMAL CONDUCTIVITY.

CONTINUOUS MAXIMUM: Refers to the maximum probable average LIQUID WATER CONTENT to be expected in STRATIFORM ICING CLOUDs as represented in Figures 1 through 3 of Appendix C of 14 CFR Parts 25 and 29.

CONTROL, AUTOMATIC: See AUTOMATIC CONTROL.

CRITICAL ICING CONDITION(S): Aircraft ICE protection meteorological and flight condition typically used as the ICE PROTECTION SYSTEM design point(s) (AIR1168/4).

CUMULIFORM: (1) Descriptor of CUMULUS family clouds, the principal characteristic of which is vertical development in the form of rising mounds, domes or towers (FAAIH, GM). (2) Cloud with the bulging appearance of a cumulus. When such clouds, arranged in lines and joined by a common base, possess protuberances giving them a turreted appearance, they are classed in the species castellanus (a type of cloud). When they constitute elements separated into tufts, they are classed in the species floccus (also a type of cloud) (WMO).

CUMULIFORM CLOUDS: A cloud species characterized by vertical development with dome-shaped tops and separated by clear spaces (FAAIH).

CUMULONIMBUS (CB): (1) CUMULIFORM CLOUD type with extreme vertical development occurring as individual cells or as a broad band with only individual tops discernable. Thunderstorm cloud. May have dense boiling "cauliflower" top or dense CIRRUS "anvil" top. Bases 1000 to 5000 ft solid growth to 30,000 ft normal, 70,000 ft extreme. HAIL, severe turbulence, airframe and powerplant icing (FAAIH). (2) A principal cloud type, exceptionally dense and vertically developed, occurring either as isolated clouds or as a line or wall of clouds with separated upper portions (GM). (3) Heavy and dense cloud, with a considerable vertical extent, in the form of a mountain or huge towers. At least part of its upper portion is usually smooth, or fibrous or striated, and nearly always flattened; this part often spreads out in the shape of an anvil or a vast plume. Under the base of this cloud, which is often very dark, there are frequently low, ragged clouds, either merged with it or not, and precipitation sometimes in the form of virga (WMO).

4. (Continued):

CUMULUS (CU): (1) CUMULIFORM CLOUD in the form of individual detailed elements which have flat bases and dome-shaped tops. Humilis-type have little vertical development or turbulence and no significant icing and are called fair-weather cumulus. Congestus-type shows towering vertical development with billowing cauliflower tops. Produces showers, strong turbulence and clear icing. Bases 1000 to 3000 ft, tops 15,000 to 20,000 ft (FAAIH). (2) A principal cloud type in the form of individual, detached elements that are generally dense and possess sharp nonfibrous outlines (GM). (3) Detached cloud generally dense and with sharp outlines, developing vertically in the form of rising mounds, domes or towers, of which the bulging upper part is often like a cauliflower. The sunlit parts are mostly brilliant white and the base is relatively dark and nearly horizontal. Sometimes cumulus clouds are ragged (WMO).

DATUM TEMPERATURE: (1) The temperature of an unheated surface in an icing environment (FAAIH). (2) Wet air boundary layer temperature for a body traversing a cloud containing free moisture (ADS-4).

DEFOG: Removal of moisture after it is condensed, usually on a transparent area. (This term may, in common usage, also include the prevention of moisture formation or be used to designate both functions, but this is not technically correct. Prevention of moisture would be anti fog.) (ARP147)

DEICE OR DEICING: (1) The removal of ICE accumulation from a surface (AS5498). (2) Removal or the process of removal of an ICE ACCRETION after it has formed on a surface (ARP147). (3) Removal of ice that has formed on aircraft surfaces (FAAIH). (See ANTI-ICE for prevention of ice formation.) (4) The periodic SHEDDING, either by mechanical or thermal means, of ice accretions by destroying the bond between the ice and the protected surface (AIR1168/4). (5) The removal of ice that has formed on airframe surfaces (ADS-4).

DEMISTER: A term used in Europe with the same meaning as DEFOG (ARP147).

DESIGN TEMPERATURE: The temperature on which the design of a system is based (ARP147).

DEW POINT TEMPERATURE: (1) The saturation temperature for a particular partial pressure of water vapor or other fluid. The temperature at which the vapor begins to condense when it is cooled at constant pressure (ARP147). (2) The temperature to which a given air parcel must be cooled at constant pressure and constant water vapor content in order for saturation to occur (GM). (3) Temperature to which a volume of air must be cooled at constant pressure and constant moisture in order to reach saturation; any further cooling causes condensation (WMO). Also known as dew point.

DIELECTRIC: An insulator or non-conducting electrical medium (FAAIH).

DRIZZLE: (1) Very small, numerous, and uniformly distributed water drops that may appear to float while following air currents. Unlike fog droplets, drizzle falls to the ground (GM). (2) Fairly uniform precipitation in very fine drops of water (diameter less than 0.5 mm) very close to one another, falling from a cloud (WMO).

4. (Continued):

DRIZZLE DROP: A drop of water of diameter 0.2 to 0.5 mm falling usually (but not always) from low stratus or stratocumulus cloud (GM). (Note that this definition is inconsistent with the GM definition given for drizzle. The reader is cautioned that the use of any one definition could cause confusion.)

DROPLET REYNOLDS NUMBER: The REYNOLDS NUMBER of a droplet in the air stream, usually based on the droplet diameter and the freestream velocity (ADS-4).

DROPLET TRAJECTORY: (1) The path of a water droplet with respect to an airfoil (ADS-4). (2) The path of the water droplet through the freestream toward, onto, and around the surface of interest (AIR1667). (3) The path of a water droplet with respect to a surface.

DRY ADIABAT: A line of constant potential temperature on a thermodynamic diagram. Same as adiabat (GM).

DRY ADIABATIC LAPSE RATE: (1) The rate of decrease of temperature with height of a parcel of dry air lifted adiabatically through an atmosphere in hydrostatic equilibrium (FAAIH). (2) A process lapse rate of temperature, the rate of decrease of temperature with height of a parcel of dry air lifted by a reversible ADIABATIC PROCESS through an atmosphere in hydrostatic equilibrium (GM). (3) Adiabatic lapse rate (about 1 °C/100 m) of dry air and also, approximately of moist unsaturated air (WMO).

DRY AIR RATED TEMPERATURE: Dry air rated temperature is defined as the temperature achieved by reducing the pressure at constant enthalpy until all the free moisture has been evaporated. If there is no free moisture present, the dry air rated temperature is equal to the AMBIENT TEMPERATURE. Dry air rated temperature can be calculated or determined from a psychrometric chart for various pressures. Equivalent air temperature which would be obtained if all free water is evaporated (ARP147).

DRY AIR TESTING: INFLIGHT tests performed to evaluate and calibrate a thermal model (that simulates any ICE protection thermal system), by measuring temperatures in the protected surface in flight at dry atmosphere conditions (basically out of visible moisture) and comparing those temperatures with the predicted temperatures for same condition (dry atmosphere, static air temperature, total air temperature, Mach No., and thermal system boundary conditions). Several conditions of altitude are performed to monitor the influence of external air temperature, and for a given altitude, different air speeds are tested to evaluate the influence of REYNOLDS NUMBER and angle of attack over the ice protection system. Every different air speed tested is kept constant until the recorded temperatures are stabilized, simulating a STEADY STATE analysis. It is then possible to extrapolate the data and cover practically all of the icing envelope.

DRY BULB TEMPERATURE: The STATIC TEMPERATURE of an air-water vapor mixture (ARP147).

4. (Continued):

DYNAMIC PRESSURE: (1) The maximum STATIC PRESSURE increase developed by the momentum of a fluid stream when its velocity is reduced to zero. ($1/2\ \rho V^2$, where ρ is density and V is velocity) (ARP147). (2) In engineering fluid mechanics, the kinetic energy, $(1/2)\rho V^2$, of the fluid, where ρ is the density and V is the speed (GM).

DYNAMIC TEMPERATURE: The difference between the TOTAL TEMPERATURE and the STATIC TEMPERATURE of a stream of compressible fluid (ARP147).

EDDY CURRENT: Current induced in the body of a conducting mass by any variation in the magnetic FLUX surrounding the mass (FAAIH).

EFFECTIVE TEMPERATURE: (1) An arbitrary index which combines into a single value the effect of air temperature, humidity, and air movement on the sensation of warmness or coldness felt by the human body. The numerical value is that of still saturated air which will induce the identical sensation (ARP147). (2) The temperature at which motionless saturated air would induce, in a sedentary worker wearing ordinary indoor clothing, the same sensation of comfort as that induced by the actual conditions of temperature, humidity, and air movement. With respect to radiation, the blackbody temperature that would yield the same amount of radiation as that emitted (GM).

ELASTOMERIC: Any substance having the properties of rubber (FAAIH).

ELECTROMAGNETIC INTERFERENCE: The field of influence produced around a conductor by the current flowing through it which contributes to a degradation in performance of an electronic receiver. Also called electrical noise, radio interference, and radio-frequency interference (FAAIH).

ELECTROTHERMAL: Electrical-resistance-generated heat used to evaporate impinging cloud droplets or melt an ICE ACCRETION.

EJECTOR: (1) A device that uses a high velocity fluid stream (called primary jet) to induce ambient fluid (secondary) flow. The DYNAMIC PRESSURE of the mixed flow is converted to a TOTAL PRESSURE in a diffuser. An ejector designed to optimize secondary/primary flow ratio is called an aspirator. An ejector designed to optimize output/secondary fluid pressure is called a jet pump. Although sometimes used for flow mixing in pneumatic systems, the primary use of an ejector in aircraft ECS is to supply cooling air for heat exchangers on the ground or in low speed or vertical flight. Normally ECS heat exchangers use ram air in flight as a cooling air source heat sink. (Military aircraft may also use fuel or an intermediate heat transport fluid.) When ram air is no longer available or is inadequate, an ejector is used to “pump” outside ambient airflow through the cooling side of the heat exchanger. Although there are a number of different ejector designs, the simplest form is to supply a high pressure bleed source through nozzle(s) located downstream of a heat exchanger. The high velocity airflow through the nozzle(s) draws (pumps) ambient airflow from upstream of the nozzle(s) and through the heat exchanger, where it is used as the heat sink (ARP147). (2) An ejector system is a common approach to hot air leading edge ICE protection.

4. (Continued):

ENGINE INDUCTION SYSTEM: Systems which provide air to an engine, e.g., the inlet lip, guide vanes, spinner, etc. for a turbine engine (FAAIH).

ENVIRONMENTAL CONTROL SYSTEM: A system designed to maintain a desired environment within an aircraft.

EQUIVALENT SPHERICAL DIAMETER: The uniform diameter an ICE shard would have after melting into a liquid water droplet (FAAIH).

EVAPORATION: (1) The physical process by which a liquid is transformed to the gaseous state; the opposite of condensation (GM). (2) (a) Emission of water vapor by the free surface of liquid water at a temperature below its boiling point. (b) Amount of water evaporated (WMO). (3) The physical process by which a liquid is transformed to the gaseous state; the opposite of condensation. Evaporation occurs, according to the kinetic theory of gases, when liquid molecules escape to the vapor stage as a result of a chance acquisition of above average, outward-directed, translational velocities. Net evaporation, also sometimes referred to as evaporation, ceases when the gas above the evaporating surface reaches saturation. However, evaporation continues after net evaporation ceases, because condensation is occurring at the same rate as evaporation. Heat removed by the evaporation process, by converting potential energy to kinetic energy, is termed the LATENT HEAT OF EVAPORATION.

EVAPORATIVE SYSTEM: Any ANTI-ICING system that supplies heat sufficient to evaporate all water droplets impinging on the heated surface (FAAIH).

FAILURE: An occurrence which affects the operation of a component such that it can no longer function as intended (AS5498).

FALSE ALARM: An indication of ICE when there is no ice present (AS5498).

FEATHERS: See ICE FEATHERS.

FEATHER RIDGE: A line of ICE FEATHERS that have grown together to form a continuous surface.

FIDS: FLIGHT ICING DETECTION SYSTEM (AS5498).

FINITE DIFFERENCE METHOD: Given a partial differential equation defined in a region of space, replacing the derivatives by difference quotients and define a grid in the region of space. A solution to the resulting finite difference problem provides an approximation to the solution of the partial differential equation. The formulation of the finite difference equation, the definition of the grid, and the solution of the equation on the grid is referred to as a finite difference method (FAAIH).

4. (Continued):

FINITE ELEMENT METHOD: The finite element method is a general technique for constructing approximate solutions to boundary value problems. The method involves dividing the domain of the solution into a finite number of simple subdomains, the finite elements, and using variational concepts to construct an approximation of the solution over the collection of finite elements (FAAIH).

FLIGHT ICING DETECTION SYSTEM (FIDS): A FIDS includes at least one sensor which is directly or indirectly sensitive to the physical phenomena of icing (AS5498).

FLOW FIELD: A vector function V which gives the velocity of the fluid at any point P in the region at any time t in the interval, given a region of space occupied by a fluid in motion during some time interval (FAAIH).

FLUX: Rate of flow per unit area (FAAIH).

FORECAST ICING CONDITIONS: Environmental conditions expected by a weather service to be conducive to the formation of INFLIGHT icing on aircraft.

FOREIGN OBJECT DAMAGE (FOD): Damage caused by debris or by an item left in an improper place.

FORWARD SCATTERING SPECTROMETER PROBE (FSSP): A commercially available instrument for counting and sizing individual cloud droplets in flight. Droplets are sized by detecting and scaling the amount of light they scatter at small angles out of a narrow illuminating beam.

FREEZING DRIZZLE (FZDZ): (1) DRIZZLE that falls in liquid form but freezes upon impact to form a coating of GLAZE (GM). (2) Precipitation in the form of drizzle-sized droplets which freeze upon contact with a below-freezing surface. (AIR1667).

FREEZING FRACTION: (1) That part of the water catch that freezes (ADS-4). (2) The amount of impinging water that freezes at the point of impingement. The portion of the impinging water not freezing on contact may freeze aft of the initial contact point (AIR1667). (3) That part or fraction of the water catch that freezes on a surface.

FREEZING LEVEL: The lowest altitude in the atmosphere, over a given location, at which the static air temperature is 0 °C (32 °F); the height of the 0 °C (32 °F) constant temperature surface (FAAIH, GM).

FREEZING PRECIPITATION: (1) Any form of liquid precipitation that freezes upon impact with the ground or exposed objects, that is, FREEZING RAIN, FREEZING DRIZZLE, or freezing fog (GM). (2) Precipitation drops freezing on impact to form a coating of CLEAR ICE (GLAZE) on the ground and on exposed objects (WMO). (3) Freezing rain and/or freezing drizzle.

4. (Continued):

FREEZING RAIN (FZRA): (1) RAIN at temperature slightly below freezing and characterized by relatively large water droplets that may freeze in contact with airframe surfaces (ADS-4). (2) Rain that falls in liquid form but freezes upon impact to form a coating of GLAZE upon the ground and on exposed objects (GM). (3) Precipitation in the form of large water droplets which become SUPERCOOLED and freeze upon contact with a below-freezing surface within a below-freezing air mass (AIR1667).

FROST: (1) Frozen moisture condensed from the atmosphere (AS5498). (2) The fuzzy layer of ICE CRYSTALS on a cold object, such as a window or bridge, that forms by direct deposition of water vapor to solid ICE (GM). (3) A covering of minute ice crystals uniformly distributed on the surface of an object.

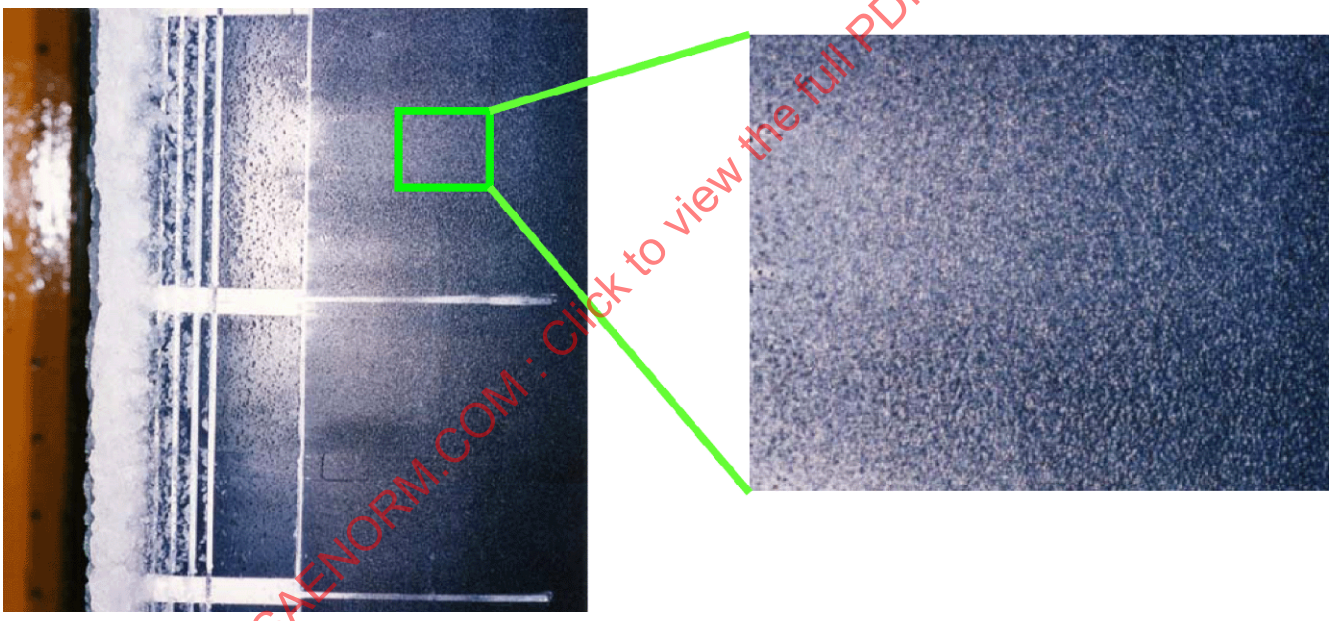


FIGURE 5 - Frost

FROZEN PRECIPITATION: PRECIPITATION in the frozen state. SNOW PELLETS and ICE PELLETS are examples of frozen precipitation.

FROZEN RIVULET: Surface water RIVULETs that freeze into streaks of ICE.

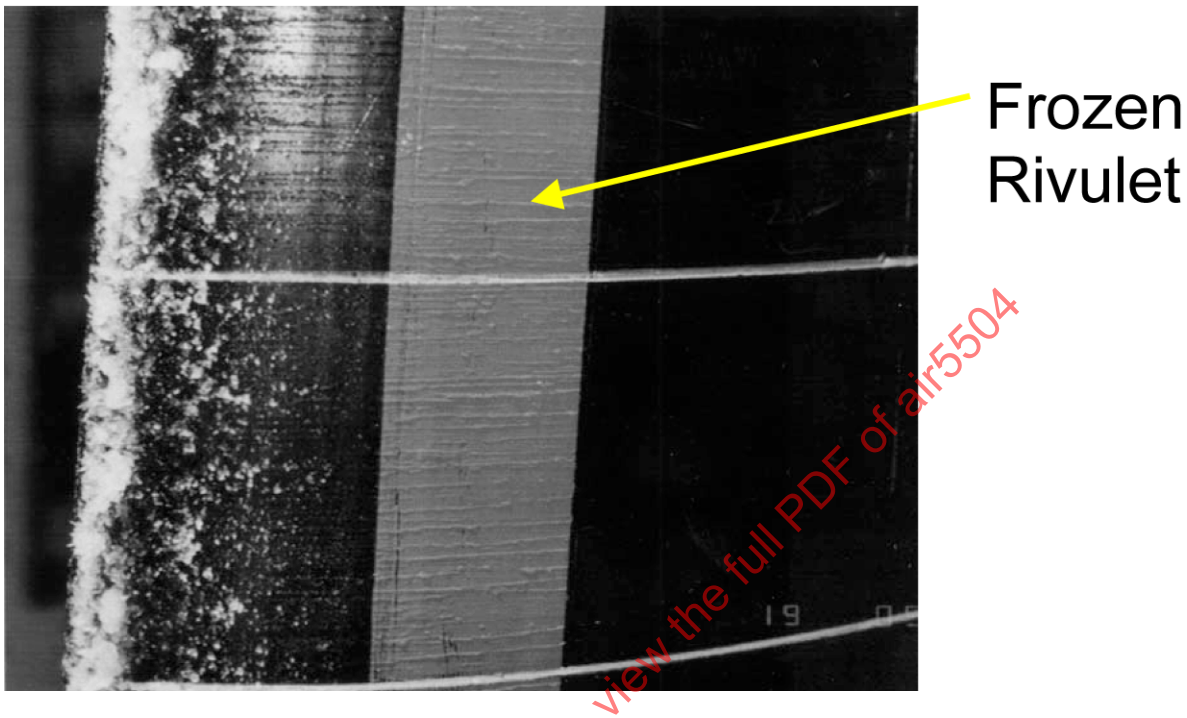


FIGURE 6 - Frozen Rivulet

4. (Continued):

GEOMETRY: A geometry is a physical surface or test object, especially with reference to the mathematical description of the shape. This term is loosely synonymous with "surface," body," "object," or "shape" (FAAIH).

G-FORCE: A dimensionless descriptor relative to normal of the force acting upon an object due to gravity where two G's would infer a weight doubling due to twice the gravitational pull upon the object mass. Also used to describe acceleration or centrifugal reactive forces (FAAIH).

GLAZE FEATHERS: ICE FEATHERS that are transparent or translucent in appearance.

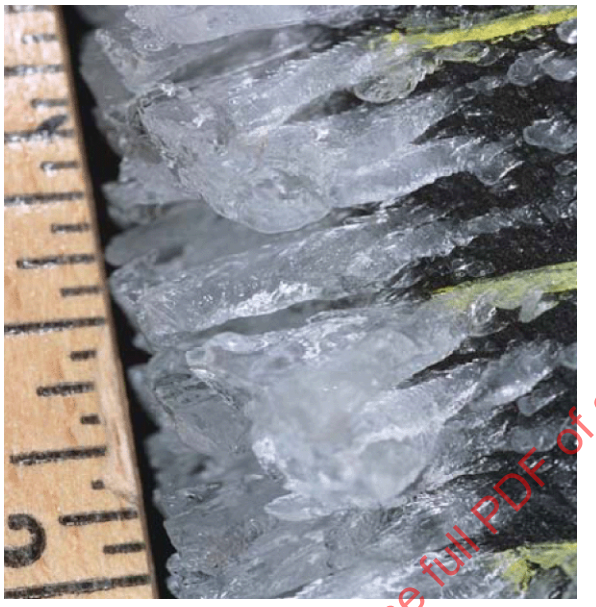


FIGURE 7 - Glaze Feathers (small markings - 1/16 inch)

4. (Continued):

GLAZE ICE: (1) Coating of generally clear, smooth ICE deposited on surfaces exposed to a film of SUPERCOOLED water (FAAIH). (2) Coating of generally clear, smooth ice deposited on surfaces exposed to a film of supercooled water. Glaze ice usually contains some air pockets (FAAIH). (3) Transparent or translucent ice formed by liquid water droplets which do not freeze immediately on impact (AS5498). (4) Transparent or translucent coating with glassy surface formed by contact with RAIN; part freezes on impact, most flowing back and freezing over surface (Jane's). (5) CLEAR ICE with rapid growth rate and characteristic "double horn" or "mushroom" formation. (This term is also used by pilots to describe a smooth film of ice covering leading edges at temperatures just below freezing (ADS-4). (6) A coating of ice, generally clear and smooth but usually containing some air pockets, formed on exposed objects by the freezing of a film of supercooled water deposited by rain, DRIZZLE, fog, or possibly condensed from supercooled water vapor (GM). (7) A smooth compact deposit of ice, generally transparent, formed by the freezing of supercooled drizzle droplets or raindrops on objects the surface temperature of which is below or slightly above 0 °C (WMO). (8) Transparent ice formed during flight in clouds by the slower freezing of supercooled water droplets (AIR1667). (9) Transparent or translucent ice formed by liquid water droplets that do not freeze immediately on impact and has HORNs. (10) A coating of ice, sometimes clear and smooth, but usually containing some air pockets which result in a lumpy translucent appearance. Glaze ice results from supercooled liquid water striking a surface, but not freezing instantaneously on contact. Glaze ice is denser, harder and sometimes more transparent than RIME ICE. Factors which favor glaze formation are those which favor slow dissipation of the heat of fusion (i.e., slight supercooling and rapid accretion).

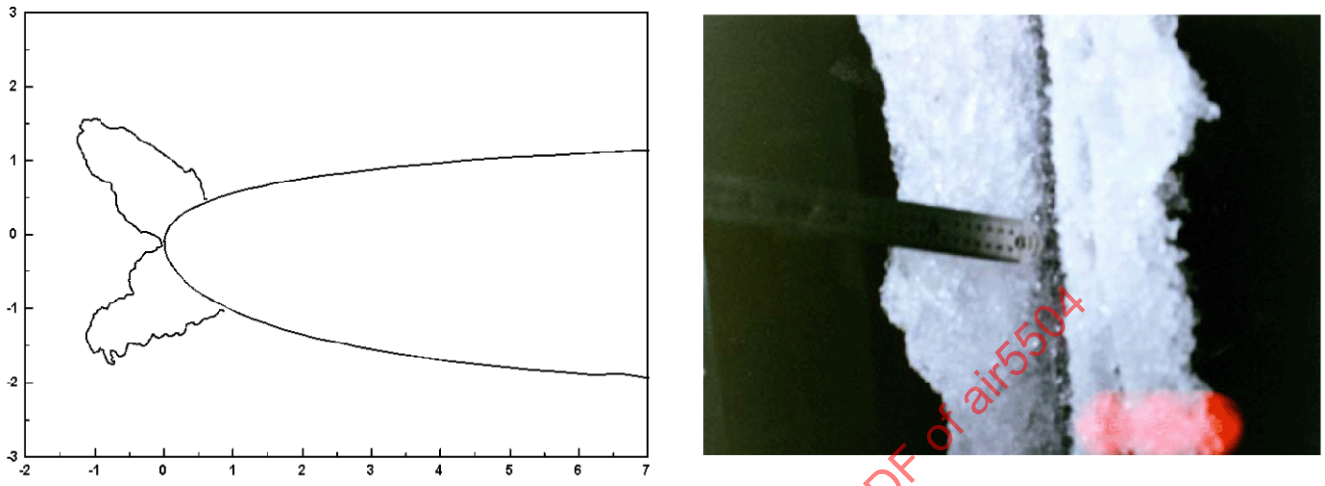


FIGURE 8 - Glaze Ice Tracing and Photograph Showing Horns

4. (Continued):

GLIME: (1) A mixture of GLAZE ICE and RIME ICE, generally with rough surfaces and RUNBACK ICE. See MIXED ICE (AIR1667). (2) An ICE coating with a consistency intermediate between glaze and rime (GM).

GLYCOL: A common freezing point depressant.

GRAUPEL: (1) Heavily rimed SNOW particles, often called SNOW PELLETS; often indistinguishable from very small soft HAIL except for the size convention that hail must have a diameter greater than 5 mm. Sometimes distinguished by shape into conical, hexagonal, and lump (irregular) graupel (GM). (2) See snow pellets.

HAIL: (1) Solid precipitation in the form of balls or pieces of ICE with diameters ranging from 5 mm to more than 50 mm (FAA29-2). (2) Precipitation in the form of balls or irregular lumps of ice, always produced by convective clouds, nearly always CUMULONIMBUS (GM). (3) Precipitation of either transparent, or partly or completely opaque particles of ice (hailstones), usually spheroidal, conical or irregular in form and of diameter very generally between 5 and 50 mm, which falls from a cloud either separately or agglomerated into irregular lumps (WMO).

HANDLING QUALITIES: The flight characteristics of an aircraft that are associated with the stability of the flight vehicle, the stall characteristics of the lifting surfaces, and the aerodynamics of the airframe. The term is commonly used to describe a pilot's perception of aircraft performance resulting from control commands, emphasizing aerodynamic changes produced by INFLIGHT ICE ACCRETION when used in an icing context.

4. (Continued):

HEAT TRANSFER COEFFICIENT, OVERALL: The single coefficient which describes the heat transfer rate through the section under consideration. It is the combination of all the individual heat transfer paths through the section and is usually expressed in units of W/m^2-°K (Btu/hr-ft^2-°F).

HEAT TRANSFER COEFFICIENT, SURFACE OR FILM: The conductance of the thin layer of fluid immediately adjacent to the surface and is usually expressed in units of W/m^2-°K (Btu/hr-ft^2-°F).

HEAVY ICING: (1) Icing resulting from flight in a SUPERCOOLED cloud with a LIQUID WATER CONTENT of 0.50 g/m^3 or greater (AGARD). (2) Icing resulting from flight in a supercooled cloud with a liquid water content above 1.0 g/m^3 (USAAMRDL). (Note that these definitions are inconsistent. The reader is cautioned that the use of any one definition could cause confusion.)

HIGHLIGHT: The forward most point on the leading edge of an airfoil, usually along the chord line. The minimum x-coordinate of an airfoil or nacelle cross-section.

HOARFROST: (1) ICE CRYSTALS deposited directly from water vapor onto surfaces that are below freezing (AIR1667). (2) A deposit of interlinking ice crystals (hoar crystals) formed by direct deposition on objects, usually those of small diameter freely exposed to the air, such as tree branches, plant stems and leaf edges, wires, poles, etc. (GM). (3) Deposit of ICE, which generally assumes the form of scales, needles, feathers or fans and which forms on objects whose surface is sufficiently cooled, usually by nocturnal radiation, to bring about the direct sublimation of the water vapour contained in the ambient air (WMO).

HORIZONTAL EXTENT: The horizontal distance of an ICING ENCOUNTER (FAAIH).

HORN: The dominant ICE growth feature of some GLAZE ICE accretions. (See also glaze ice and illustration for glaze ice.)

HOT WIRE ANEMOMETER: A velocity measurement device that measures heat transfer in a FLOW FIELD by passing electrical current through a thin element exposed to the flow. In its most common form, the device maintains a constant temperature in the element and measures the current required to maintain the temperature.

HUMIDITY, RELATIVE: See RELATIVE HUMIDITY.

HUMIDITY, SPECIFIC: See SPECIFIC HUMIDITY.

HYDROSTATIC EQUILIBRIUM: The state of a fluid whose surfaces of constant pressure and constant mass (or density) coincide and are horizontal throughout (FAAIH, GM).

ICE: (1) Any form of frozen water including GLAZE ICE, RIME ICE, FROST, RUNBACK ICE, SNOW, and ICE CRYSTALS (AS5498). (2) Any form of frozen water accretion including glaze ice and rime ice, frost, runback ice, snow, and ice crystals, including MIXED PHASE conditions. (3) The solid, crystalline form of water substance.

4. (Continued):

ICE ACCRETION: A growth or buildup of ICE; an ice formation (ADS-4).

ICE CAP: An ICE ACCRETION.

ICE-CONTAMINATED TAILPLANE STALL (ICTS): (1) The local flow separation on the suction surface (which is the lower surface) of a horizontal tail caused by an ICE ACCRETION on the leading edge. This stall causes a loss in horizontal tail lift. The resulting nose-down aircraft moment is aggravated by the increase in wing downwash if the pilot increases aircraft attitude in an attempt to increase horizontal tail download to trim the aircraft. (2) Premature flow separation from the suction surface of a horizontal tail caused by an ice accretion on the leading edge. The tail angle of attack where ICTS occurs is affected by the tail airfoil design, the ice shape & roughness, Reynolds & Mach numbers, and elevator deflection angle.

ICE CRYSTALS: (1) Various macroscopic crystalline formations with a basic hexagonal symmetry although, depending upon the condition of temperature and vapor pressure, the simple hexagonal pattern may be almost indiscernible. Ice crystals are common in the atmosphere with the high clouds (>6060 m (20,000 ft)) being formed almost entirely of ice crystals (FAAIH). (2) Any one of a number of macroscopic, crystalline forms in which ICE appears, including hexagonal columns, hexagonal platelets, dendritic crystals, ICE NEEDLES, and combinations of these forms (GM). (3) Any one of a number of macroscopic crystalline forms of ice including hexagonal columns and platelets, dendritic crystals, ice needles and their combinations (WMO). (4) Frozen supercooled water droplets (AIR1667).

ICE CRYSTAL CLOUDS: (1) Glaciated clouds existing usually at very cold temperatures where moisture has frozen to the solid or crystal state (FAA29-2). (2) A cloud consisting entirely of ICE CRYSTALS (such as CIRRUS); to be distinguished in this sense from water clouds and mixed clouds (GM).

ICE DEPTH GAGE: A device used to measure ICE thickness or the height of an ice feature, such as an ice HORN, from the surface of the article upon which the ice has accreted. Since the surface of the ice is usually irregular, these devices are often set up to measure the peaks of ice over a small area.

FIGURE 9 - Ice Depth Gage

4. (Continued):

ICE DETECTOR: An ICE detector informs the cockpit crew or a system about ICE ACCRETION on monitored aeroplane surfaces (AS5498).

ICE FEATHERS: Individual structures of ICE formed from discrete points and fan out as they grow. They are found adjacent to the main ICE SHAPE and may grow into it or into each other. (See also GLAZE FEATHERS, RIME FEATHERS, and FEATHER RIDGE.)

ICE FROST: Forms on cryogenic tank; if on rocket, easily shaken off at launch (Jane's).

ICE INGESTION: Class of tests to determine ability of engine to swallow various cubes of ICE, ice-water slush, and sometimes hailstones at specified flow rates (Jane's).

ICE NEEDLES: Growth of long ICE CRYSTALS of needle appearance (Jane's).

ICE PLATE: Strong plate on fuselage skin in plane of propellers (Jane's).

ICE POINT: (1) Standard temperature and pressure equilibrium temperature for ICE/water mixture (Jane's). (2) The temperature at which a mixture of air-saturated pure water and pure ice may exist in equilibrium at a pressure of one STANDARD ATMOSPHERE (GM). (3) The true freezing point of water; the temperature at which a mixture of air-saturated pure water and pure ice exist in equilibrium at the pressure of one standard atmosphere (WMO).

4. (Continued):

ICE ROD: Standard ingestion-test size: 3.18 cm (1.25 in) in diameter by 30.5 cm (12 in) long (Jane's).

ICE KNIFE: (1) A tool to cut an ICE ACCRETION to prepare it for tracing. (2) Russian term for PARTING STRIP.

ICE PELLETS: Type of precipitation consisting of transparent or translucent pellets of ICE 5 mm or less in diameter (FAAIH, FAA29-2, GM).

ICEPHOBIC: A surface property exhibiting a reduced adhesion to ICE, literally, "ice-hating" (FAAIH).

ICE PROTECTION SYSTEM (IPS): Any airborne DEICING or ANTI-ICING system (depending on the necessary degree of protection and the capability to provide that protection) that has the primary function of protecting an aircraft surface against ICE ACCRETION. A deicing system allows some ICE to accrete on the protected surface before removing it (partially or totally) periodically, whereas an anti-icing system prevents the formation of ice on a surface. It may be essential on parts where the accretion of ice can interfere with the aircraft operation or its systems. These parts may include windshields, wing leading edges, tail airfoil leading edges, propellers, engine air inlets, water drains, and sensors (Pitot tubes, temperatures, STATIC PRESSUREs, angle of attack, etc.)

ICE RIDGE: (1) A raised line or strip of ICE that can be formed either naturally or by the activation of an ICE PROTECTION SYSTEM. Several different types of ice ridges have been identified: BOOT RIDGE, RUNBACK RIDGE, FEATHER RIDGE, STALL BAR RIDGE. (2) Ice that remains on an airfoil aft of the active area of a DEICING system, after the deicing system has been activated. One way this occurs is when ice has accreted on the airfoil over a larger area than that covered by the deicing system (see BOOT RIDGE).

ICE SHAPE: The aerodynamic shape of ICE formed on an aircraft. This shape may be calculated or based on actual accumulation during natural, tanker, or tunnel icing tests.

ICING CLOUD: Icing clouds are those containing SUPERCOOLED WATER DROPLETS in sufficient concentration to produce ICE on an aircraft surface (AIR1168/4).

ICING CODE: A computer program that models the ice accretion process in aircraft icing conditions.

ICING CONDITIONS: The presence of atmospheric moisture and temperature conducive to aeroplane icing (AS5498). The upper STATIC TEMPERATURE limit for icing is generally given as +4 °C, +40 °F, or +5 °C.

ICING ENCOUNTER: A series of ICING EVENTs consecutively penetrated until an interruption of more than some selected distance is experienced (FAAIH).

ICING EVENT: A portion of a subfreezing cloud over which the cloud properties are approximately constant (FAAIH).

4. (Continued):

ICING, HEAVY: See HEAVY ICING.

ICING INTENSITY: (1) The relationship of the terms of TRACE, LIGHT, MODERATE, and HEAVY to the cloud LIQUID WATER CONTENT (AIR1667). (2) Rate at which ICE ACCRETION occurs, expressed in units of depth per unit time (GM).

ICING, LIGHT: See LIGHT ICING.

ICING LIMITS: (1) Distance from the STAGNATION POINT to the end of the ICE ACCRETION on both the upper and lower surfaces of an airfoil. (2) Distance from the HIGHLIGHT to the end of the ice accretion on both the upper and lower surfaces of an airfoil. (3) Usually upper and lower temperature limits, corresponding to one (sometimes two) flight levels.

ICING, MODERATE: See MODERATE ICING.

ICING, SEVERE: See SEVERE ICING.

ICING SEVERITY DETECTION AND INDICATION SYSTEM: A system to inform an aircrew of the current environmental conditions and the degradation of aircraft performance under any icing condition.

ICING TANKER: Aircraft equipped to cause severe icing on another following close behind (Jane's).

ICING, TRACE: See TRACE ICING.

ICING TUNNEL: A wind tunnel equipped to cause icing on a test model or instrument placed in the tunnel.

ICE SHAPE DETERMINATION: A term indicating whether a specific icing code has the theoretical capability to produce a computed ICE SHAPE.

IMPACT ICE: ICE formed due to the ballistic collision of a SUPERCOOLED WATER DROPLET and an aircraft surface.

IMPEDANCE: The total opposition (i.e., resistance plus reactance) a circuit offers to alternating current at a given frequency (FAAIH).

IMPINGEMENT EFFICIENCY CURVE: A plot of the local impingement parameter ß versus the surface distance parameter S for an airfoil or other two-dimensional object. Also known as a ß-curve (FAAIH).

4. (Continued):

IMPINGEMENT LIMIT: (1) The location farthest aft on a body at which water droplets impinge. It governs the extent of protection to be provided (AIR1168/4). (2) Distance from the STAGNATION POINT to the end of the water impingement region on both the upper and lower surfaces of an airfoil (ADS-4).

INDUCTANCE: Property of a circuit that tends to oppose any change of current because of the magnetic field associated with the current itself. The unit of inductance is the "henry" (FAAIH).

INDUCTIVE REACTANCE: The opposition to the flow of alternating current as measured in ohms due to the INDUCTANCE of a circuit (FAAIH).

INERTIA PARAMETER: A dimensionless parameter used to correlate water droplet impingement data (ADS-4).

INFLATION CYCLE: The length of time between inflation of the deicer tubes for a PNEUMATIC DEICER. Typical aircraft inflation cycles for pneumatic deicers are one minute and three minutes. The aircraft manufacturer may also refer to these as “fast” and “slow” or “heavy” and “light.” Selection of the appropriate inflation cycle is a function of the rate at which ICE builds on the surface of the deicer in flight. Inflation cycles may be variable. A couple of examples are if an ICE DETECTOR is used to automatically activate the DEICING system or if the pilot is visually judging the thickness of the ice and manually activating the deicing system.

INFLIGHT: From weight off wheels to weight on wheels (AS5498).

INFRARED IMAGERY: A non-contacting method of temperature measurement wherein the radiation generated by the temperature of an object is measured in such way that its temperature can be ascertained. A two-dimensional image is formed indicating the temperature variation across the surface of the object.

INTERCYCLE ICE: The ICE ACCRETION on a deiced surface that exists just prior to the actuation of the DEICE system.

INTERMITTENT MAXIMUM: Refers to the maximum probable LIQUID WATER CONTENT to be expected in convective ICING CLOUDs as represented in Figure 4 of 14 CFR Parts 25 and 29, Appendix C.

INTRUSIVE: A FIDS in which the sensing component is located outside the boundary layer (AS5498).

IPS: ICE PROTECTION SYSTEM

ISD&IS: Icing Severity Detection and Indication System

JAR: Joint Aviation Requirement

4. (Continued):

KCAS: Knots Calibrated Air Speed

KNOWN ICING CONDITIONS: Atmospheric conditions in which the formation of ICE is observed or detected in flight.

LANGMUIR DISTRIBUTION: A theoretical family of drop size distributions based on percentages of LIQUID WATER CONTENT of each droplet size (FAAIH).

LATENT FAILURE: A failure that is unrecognized until it is made known to the cockpit crew or maintenance personnel (AS5498).

LATENT HEAT: (1) The specific enthalpy difference between two phases of a substance at the same temperature. The latent heat of vaporization is the water vapor specific enthalpy minus the liquid water specific enthalpy. The latent heat of fusion is the specific enthalpy of water minus that of ICE and the latent heat of sublimation is the specific enthalpy of water vapor minus that of ice (GM). (2) Amount of energy released or absorbed during a change of state of a substance. In meteorology, the important changes are those of water substance, energy being released to the surrounding air in the changes from vapour to liquid to solid and absorbed from the air during changes in the opposite sense (WMO). (3) The energy required to change a substance from one state to another.

LATENT HEAT OF CONDENSATION: The energy released when water vapor condenses to form liquid droplets.

LATENT HEAT OF EVAPORATION: The energy required to change a liquid to a gas.

LATENT HEAT OF FUSION: (1) See LATENT HEAT (GM). (2) The energy required or released when a substance is changed from a solid to liquid or from a liquid to a solid.

LATENT HEAT OF SUBLIMATION: The energy required or released when a substance is changed from a solid to a gas or from a gas to a solid.

LIGHT ICING: (1) The rate of accumulation that may create a hazard if flight is prolonged in this environment. Occasional use of DEICING/ANTI-ICING equipment removes/prevents accumulation (FAAIH). (2) The rate of accumulation that may create a hazard if flight is prolonged in this environment (over 1 h). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti-icing equipment is used (AIR1667). (3) The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 h). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if deicing/anti-icing equipment is used (AIM, FG). (4) Icing resulting from flight in a SUPERCOOLED cloud with a LIQUID WATER CONTENT between 0.125 and 0.25 g/m^3 (AGARD). (5) Icing resulting from flight in a supercooled cloud with a liquid water content between 0.1 to 0.5 g/m^3 (USAAMRDL). (Note: It is recognized that the accuracy of some of these definitions is questionable. Note also that some are inconsistent. The reader is cautioned that the use of any one definition could cause confusion.)

4. (Continued):

LIQUID WATER CONTENT: (1) The total mass of water contained in liquid cloud droplets within a unit volume of cloud, usually given in units of grams of water per cubic meter of air (g/m^3) (AIR1667, FAAIH). (2) Water contained as free moisture in a volume of air (does not include water in vapor form) (ADS-4).

LOCAL CATCH EFFICIENCY: (1) The local catch divided by that which would be caught on 1 ft^2 of surface area with a catch efficiency of unity (AIR1168/4). (2) The percentage of water droplets of a given size intercepted by a small element of an airfoil compared to the number of droplets of the same size in the free air upstream of the airfoil.

LOCAL WATER CATCH: Local water catch is the point-by-point distribution of water (or ICE), in lb/hr-ft^2 surface area, over the impingement area (AIR1168/4).

LUDLAM LIMIT: (1) The point at which some SUPERCOOLED WATER DROPLETS no longer freeze within their catchment area and the forward growth of ICE is diminished (AIR1667). (2) The combination of TOTAL TEMPERATURE, LWC, and airspeed at which not all supercooled water droplets freeze within their catchment area and the forward growth of ice is diminished.

LWC: LIQUID WATER CONTENT.

MAGNETOSTRICTIVE: The property of a ferromagnetic material that causes it to change dimensions and vibrate when subjected to a high frequency magnetic field. In ICE DETECTORs, the shift in resonant frequency is used to indicate ICE buildup (AIR4367).

MED: MEAN EFFECTIVE DIAMETER

MEAN EFFECTIVE DIAMETER (MED): The droplet diameter which divides the total water volume present in the droplet distribution in half, i.e., half the water volume will be in larger drops and half the volume in smaller drops. The value is calculated, based on an assumed droplet size distribution (FAAIH). See also ROTATING MULTICYLINDER.

MEDIAN VOLUMETRIC DIAMETER (MVD): (1) The droplet diameter which divides the total water volume present in the droplet distribution in half, i.e., half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements (FAAIH). (2) A measure of the diameter that contributes most to cloud liquid water or mass (GM). (3) The droplet diameter, usually in MICRONS (10^{-6} m), such that one half the liquid water in an ICING CLOUD volume is contained in droplets smaller than the median volumetric diameter and one half the water in the same icing cloud volume is contained in droplets larger than the median volumetric diameter (SAE1667). (Also referred to as Median Volume Diameter).

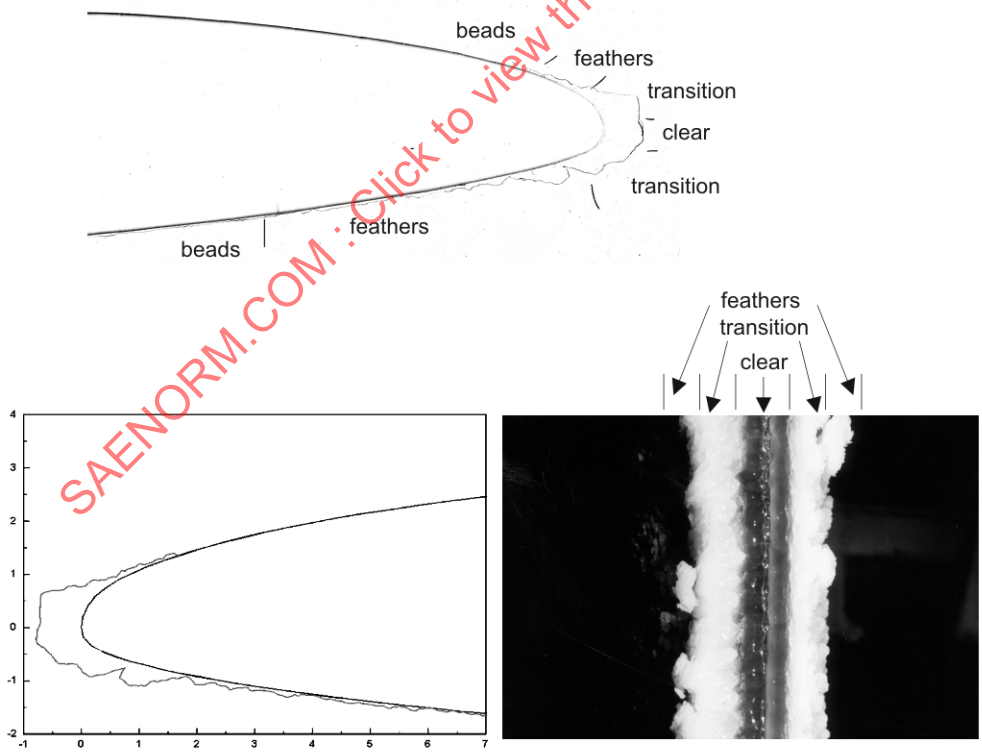
MICRON (μm): One millionth of a meter (10^{-6} m). (Also known as micrometer.)

4. (Continued):

MIXED CLOUD: (1) A subfreezing cloud composed of SNOW and/or ICE particles as well as liquid droplets (FAAIH). (2) A cloud containing both water drops (SUPERCOOLED at temperatures below 0oC) and ICE CRYSTALS, hence a cloud with a composition between that of a water cloud and that of an ice-crystal cloud (GM). (3) Cloud in which ice particles are intermingled with supercooled droplets of water (WMO).

MIXED CONDITIONS: (1) Partially glaciated clouds at AMBIENT TEMPERATUREs below 0 °C (32 °F) containing a mixture of ICE CRYSTALS and SUPERCOOLED WATER DROPLETS (FAA29-2). (2) Mixture of supercooled water droplets and ice crystals existing within the same cloud environment (AIR1667).

MIXED ICE: Simultaneous appearance of both GLAZE ICE and RIME ICE characteristics. It is translucent or transparent at the stagnation region, transitioning to opaque ICE FEATHERS at the sides.



Mixed ice component description, tracing (in inches), and photograph

FIGURE 10 - Mixed Ice Component Description, Tracing (in inches) and Photograph

4. (Continued):

MIXED PHASE ICING/MIXED ICING: Icing in a cloud composed of SUPERCOOLED DROPLETS and ICE CRYSTALS.

MODERATE ICING: (1) The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/ANTI-ICING equipment or diversion from the area and/or altitude is necessary (AIR1667, FAAIH). (2) The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or diversion is necessary (FAAIH). (3) The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or flight diversion is necessary (AIM, FG). (4) Icing resulting from flight in a SUPERCOOLED cloud with a LIQUID WATER CONTENT between 0.25 and 0.50 g/m^3 (AGARD). (5) Icing resulting from flight in a supercooled cloud with a liquid water content between 0.5 and 1.0 g/m^3 (USAAMRDL). (Note that some of these definitions are inconsistent. The reader is cautioned that the use of any one definition could cause confusion.)

MOIST ADIABAT: On a thermodynamic diagram, an isopleth (a line of constant value of a quantity with respect to time or space) of equivalent potential temperature or pseudoequivalent potential temperature. Moist adiabats on most diagrams are drawn for the pseudoadiabatic process in which liquid water is removed as soon as it is condensed. Also called saturation adiabat (GM).

MOIST ADIABATIC LAPSE RATE: The rate of decrease of temperature with height along a MOIST ADIABAT (GM).

MOIST ADIABATIC PROCESS: An adiabatic process for which the air is saturated and may contain liquid water (GM).

MONITORED SURFACE: The surface of concern regarding ICE hazard (e.g., the leading edge of a wing) (AS5498).

MTBF: Mean Time Between Failures.

MTBUR: Mean Time Between Unscheduled Removals.

MULTISTEP ICE ACCRETION PROCEDURE: A time-stepping procedure used in computer code icing simulations to "grow" the ICE ACCRETION, calculates the amount of ICE accumulated on the surface during a specified time increment, and repeats that calculation over a sufficient number of time increments that total to the desired exposure time.

MUSHROOM ICE: CLEAR ICE with rapid growth rate and characteristic “double HORN” formation, also known as “GLAZE ICE” (ADS-4).

MVD: MEDIAN VOLUMETRIC DIAMETER.

NATURAL ICING: Icing that occurs during a flight in a cloud formed by nature (AIR1667).

4. (Continued):

NAVIER-STOKES EQUATIONS: (1) The general equations which describe a viscous, compressible flow in a region of space (FAAIH). (2) The equations of motion for a viscous fluid (GM):

$$\frac{du}{dt} = -\frac{1}{\rho}\nabla P + F + v\nabla u + \frac{1}{3}v\nabla(\nabla \bullet u) \qquad \text{(Eq. 1)}$$

where P s the pressure, ρ the density, F the total external force, u is the fluid velocity, and n the kinematic viscosity.

NAVIER-STOKES SOLVER: A computer code which implements a numerical method for the solution of the Navier-Stokes equations or a simplified version of those equations (e.g., the THIN[-LAYER] NAVIER-STOKES EQUATIONS) (FAAIH).

NIMBOSTRATUS (Ns): (1) A low level (<6500 ft) STRATIFORM cloud, gray or dark colored and often with a ragged base and a diffused appearance due to almost continuous DRIZZLE, RAIN, SNOW, or ICE PELLETS. Little turbulence, but can create serious icing problems (FAAIH). (2) A principal cloud type, gray colored and often dark, rendered diffuse by more or less continuously falling rain, snow sleet, etc., of the ordinary varieties and not accompanied by lightning, thunder, or HAIL (GM). (3) Grey cloud layer, often dark, the appearance of which is rendered diffuse by more or less continuously falling rain or snow, which in most cases reaches the ground. It is thick enough throughout to blot out the Sun. Low, ragged clouds frequently occur below the layer, with which they may or may not merge (WMO).

NODULES: (1) Smooth, individual ICE structures similar to GLAZE FEATHERS which grow nearly perpendicular to the general airflow direction; usually found on the surface on an airfoil away from the direct impingement zone. (2) SLEET, See ICE CRYSTALS (AIR1667).

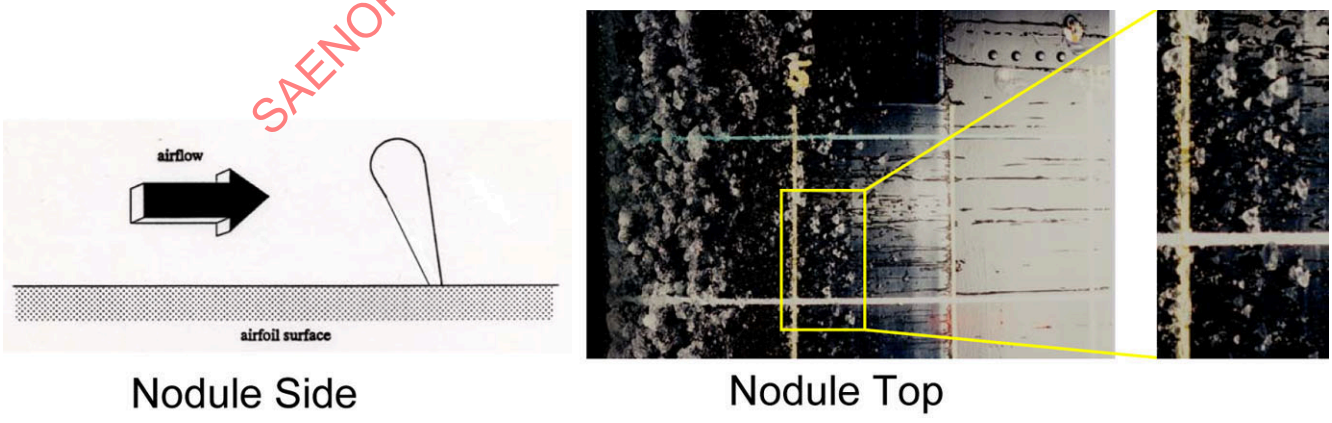


FIGURE 11 - Nodules

4. (Continued):

NUCLEATION: (1) In meteorology, the initiation of either of the PHASE CHANGEs from water vapor to liquid water, or from liquid water to ICE (FAAIH). (2) The initiation of either of the phase changes from water vapor to liquid water, or from liquid water to ice (AIR1168/4). (3) The process of initiation of a new phase in a SUPERCOOLED (for liquid) or supersaturated (for solution or vapor) environment; the initiation of a phase change of a substance to a lower thermodynamic energy state (vapor to liquid condensation, vapor to solid deposition, liquid to solid freezing) (GM). (4) Action of special particles, termed “nuclei”, in the passage from the vapour phase of a substance to the liquid or solid phase, or from the liquid to the solid phase (WMO).

NUISANCE ALARM: An undesired indication of ICE or icing (AS5498).

OAT: Outside Air Temperature, see AMBIENT TEMPERATURE.

OBSERVED ICING: Actual ICE observed visually on the aircraft by the flight crew, or identified by on-board sensors.

OHMIC DROP: A drop (loss) of an electrical current's ability to do work as measured in ohms due to the resistance of a wire or circuit (FAAIH).

OPTICAL ARRAY PROBE (OAP): A commercially available instrument for counting and sizing individual, precipitation-sized particles in flight. Particles are sized by electronically measuring the diameter of the magnified shadows of particles passing through a narrow light beam.

PANEL METHOD: A numerical method for calculating the incompressible, inviscid flow about a two- or three-dimensional body or configuration of arbitrary shape. The body is represented by panels (which may be line segments in two dimensions and planar regions bounded by polygons in three dimensions) (FAAIH).

PARTING STRIPS: (1) In a cyclic-electrical DEICING system, continuously heated areas about 2 cm (1 in) wide (either spanwise or chordwise) which divide the ICE into discrete portions (ADS-4). (2) Areas that are anti-iced (usually RUNNING WET) and are generally located in proximity to the stagnation line of an airfoil that is electrothermally deiced. The parting strip “parts” the ice formation (or ICE CAP) so that aerodynamic forces cannot hold it against the surface of the airfoil. The parting strip is usually bounded on each side by a time cycled DEICE zone. Chordwise parting strips can also be used at either end of the deicer to prevent ice BRIDGING to non-heated parts of the aircraft or the parting strips can be placed between adjacent deice zones which are not concurrently heated. The Russian term for parting strips is ICE KNIVES.

4. (Continued):

PHASE CHANGE: (1) The process of changing from one physical state to another physical state. In ECS, phase change is usually in reference to materials selected that will change phase at a specific operating point or range. Significant heat transfer occurs when most materials change phase. This provides a significant thermodynamic advantage over absorbing or desorbing heat through the process of raising or lowering the temperature of a substance that does not change phase. Phase change materials are used passively or in a thermodynamic cycle such as the refrigeration system vapor cycle (ARP147). (2) A thermodynamic process in which a substance changes from one phase to another (GM). (3) The process of matter changing from one physical state to another physical state. In icing a change of icing particles between a solid form to liquid form and from a SUPERCOOLED form to vapor form. Significant energy is required to change the phase of icing particles while preventing ICE accumulation.

PHENOLIC (MATERIAL): Any one of several thermosetting plastic materials available which may be compounded with fillers and reinforcing agents to provide a broad range of physical, electrical, chemical, and molding properties (FAAIH).

PICCOLO TUBE: (1) Tube with small, regularly spaced holes for distribution of ANTI-ICING air to leading edges (ADS-4). (2) A pressurized high temperature tube behind the surface to be protected (such as an airfoil or engine inlet leading edge) that distributes heated air in the spanwise direction; so named due to its similarity to the piccolo musical instrument. Small holes are placed along this tube to direct the pressurized hot air in a jet like fashion onto the interior surface of the leading edge, thereby heating up the leading edge to evaporate impinging water or melt ICE particles.

PIREPS: (1) PIlot REPortS. Commonly used by pilots to record meteorological events experienced during INFLIGHT operations (AIR1168/4). (2) The aviation communications code word and commonly used contraction for pilot report (GM).

PLANAR COIL: A number of turns of wire lying essentially in a single plane and within a form made of insulating material. The wire turns introduce INDUCTANCE into the electric circuit and produce a magnetic FLUX (FAAIH).

PNEUMATIC BOOT: This term is anecdotal and synonymous with PNEUMATIC DEICER. Early in their development pneumatic deicers were also referred to as “overshoes” as they used mechanical fastening means, including zippers, for attachment to the aircraft surface(s) to be protected.

PNEUMATIC DEICER: A mechanical deicer usually made from fabric and ELASTOMERIC materials, having internal tubes (or passageways) which are periodically inflated with BLEED AIR taken from a turbine engine or another air source. Pneumatic deicers are generally bonded directly to the surface to be protected, but may also be installed into a recessed leading edge or co-manufactured into a composite leading edge to provide an aerodynamically smooth surface.

4. (Continued):

POTENTIAL FLOW: (1) Given a FLOW FIELD specified by a vector function V, if V can be written as:

$$V = \nabla\varphi \qquad \text{(Eq. 2)}$$

for some scalar function φ, then the flow is referred to as a potential flow (and φ is called the potential function). Inviscid, irrotational flows are potential flows (FAAIH). (2) Potential flow theory: Irrotational, inviscid, free-slip flow for which Bernoulli's equation applies along a streamline (GM).

POTENTIAL ICING CONDITIONS: Atmospheric conditions conducive to ICE ACCRETION on aircraft components. These conditions are typically defined by visible moisture and temperatures colder than a specific temperature. These conditions are normally defined by the aircraft manufacturer.

PREDICTOR-CORRECTOR PROCEDURE: A well-developed process of iterating to a converged solution for a given grid point or line of points in a marching procedure, whether temporal or spatial. In this process, first the equations are solved for the new predicted values and subsequently the predicted values are used to update the solution or "correct" it. This process is used for trajectory calculations in LEWICE3D and LEWICE 2.0. The predictor-corrector approach is applied to the complete ICE ACCRETION calculation in the ONERA and HERICE codes (the codes first predict a final ICE SHAPE and then that ICE shape is used to determine the changes in parameters such as IMPINGEMENT LIMITs or COLLECTION EFFICIENCY and this information is then used to go back and recalculate the ice shape assuming a linear variation in icing parameters from the initial values to the "predicted" final values.)

PRESSURE ALTITUDE: The altitude corresponding to a given pressure in the STANDARD ATMOSPHERE.

PRESSURE, DYNAMIC: See DYNAMIC PRESSURE.

PRESSURE, STATIC: See STATIC PRESSURE.

PRESSURE, TOTAL: See TOTAL PRESSURE.

PRIMARY AUTOMATIC FIDS: A FIDS that automatically activates ANTI-ICING or DEICING systems (AS5498).

PRIMARY MANUAL FIDS: A FIDS that annunciated the presence of ICING CONDITIONS and then the cockpit crew activates the ICE PROTECTION SYSTEM based on the FIDS output (AS5498).

4. (Continued):

RAIN: (1) Precipitation in form of water droplets making noticeable individual impact, diameter roughly 1 to 5.5 mm (Jane's). (2) Precipitation in the form of liquid water drops that have diameters greater than 0.5 mm, or, if widely scattered, the drops may be smaller (GM). (3) Precipitation of liquid water particles, either in the form of drops of more than 0.5 mm in diameter, or of smaller widely scattered drops (WMO). (4) Precipitation near the ground or aloft in the form of liquid water drops which have maximum diameters greater than 0.5 mm (500 microns). (5) Precipitation on the ground or aloft in the form of liquid water drops which have diameters greater than 0.5 mm.

RAIN ICE: Most dangerous airframe icing; similar to GLAZE ICE and caused by SUPERCOOLED raindrops which take sufficiently long to freeze for RUNBACK to be extensive (Jane's).

RAM TEMPERATURE RISE: That positive increment of temperature achieved by reducing the relative velocity between the aircraft and the ambient air. Ram temperature rise is equivalent to the DYNAMIC TEMPERATURE rise when the relative velocity is zero (ARP147).

RECOVERY TEMPERATURE: The resulting temperature of a fluid stream when it is brought to rest. It is determined from the freestream temperature using a recovery factor (ARP147).

$$T_r = T_o[1 + r(\{\gamma - 1\}/2)M^2] \qquad \text{(Eq. 3)}$$

where:

T_r = recovery temperature
T_o = freestream static temperature
r = recovery factor
γ = specific heat ratio
M = Mach number

REDUNDANCY: The presence of more than one independent means for accomplishing a given function or flight operation (AS5498).

REFERENCE SURFACE: The surface where a FIDS sensor makes its measurement (e.g., the INTRUSIVE part of a probe system) (AS5498).

RELATIVE HUMIDITY: (1) The ratio of the partial pressure of water vapor in the air to the partial pressure which saturated water vapor exerts at the same air temperature (ARP147). (2) The ratio of the partial pressure of water vapor in the air to saturation vapor pressure with respect to water (GM).

RESIDUAL ICE: ICE remaining after actuation of a DEICE type of ice protection system.

4. (Continued):

REYNOLDS NUMBER: (1) A dimensionless parameter which is the ratio of the inertia force to viscous force for a given problem. It is calculated according to the formula:

$$Re = \rho_a VL/\mu \qquad \text{(Eq. 4)}$$

where V is a characteristic velocity, ρ_a is the density of air, μ is the viscosity of air, and L is a CHARACTERISTIC LENGTH for the problem (FAAIH). (2) The dimensionless ratio of the inertial force ($\sim U^2/L$) to the viscous force ($\sim vU/L^2$) in the Navier-Stokes equations, where U is a characteristic velocity, L is a characteristic length, and n is the kinematic viscosity of the fluid; thus,

$$Re = UL/v \text{ (GM)} \qquad \text{(Eq. 5)}$$

RIDGE: See ICE RIDGE.

RIME FEATHERS: ICE FEATHERS that are milky or opaque in appearance and have a fine crystalline structure.

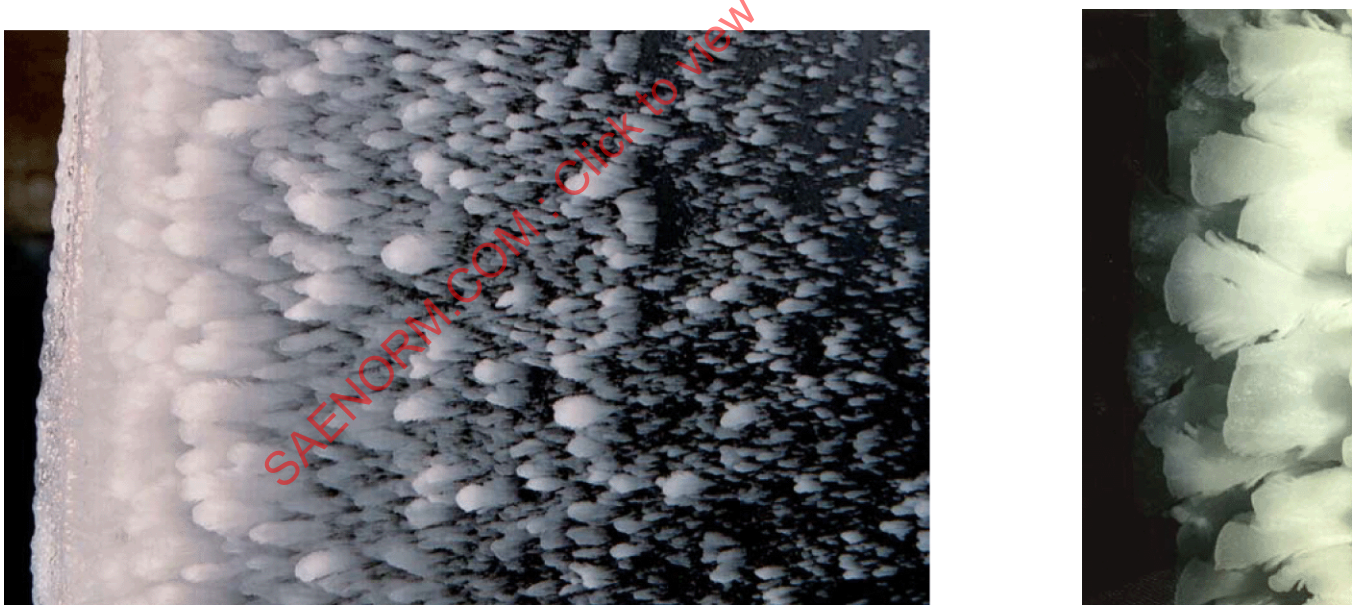


FIGURE 12 - Rime Feathers

4. (Continued):

RIME ICE: (1) A rough, milky, opaque ICE formed by the instantaneous freezing of small, SUPERCOOLED droplets as they strike the aircraft. Rime ice usually occurs at temperatures colder than about -9 °C (+15 °F), although it has been observed at somewhat warmer temperatures (FAAIH). (2) Deposit of white or milky, opaque granular ice formed by instantaneous freezing of SUPERCOOLED WATER DROPLET impingement. Rime ice usually contains tiny air pockets (FAAIH). (3) A milky, opaque ice formed by the rapid freezing of supercooled droplets (AS5498). (4) Milky white, low-density ice formed at low temperatures with a relatively streamlined shape; also referred to as spearhead and knife-edge ice (ADS-4). (5) Rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets (AIM). (6) A rough, milky, opaque ice formed by the instantaneous freezing of small supercooled droplets as they strike the aircraft. The fact that the droplets maintain their nearly spherical shape upon freezing and thus trap air between them gives the ice its opaque appearance and makes it porous and brittle (FC). (7) Same as rime, but especially applied to rime formation on aircraft. Rime: A white or milky and opaque granular deposit of ice formed by the rapid freezing of supercooled water drops as they impinge upon an exposed object (GM). (8) Deposit of ice generally formed by the freezing of supercooled fog or cloud droplets on objects the surface temperature of which is below or slightly above 0 °C (WMO). (9) Opaque ice formed during flight in clouds by the rapid freezing of small supercooled water droplets producing a streamlined spear shape. This type of ice occurs below the LUDLAM LIMIT (AIR1667). (10) Milky and opaque ice formed by liquid water droplets that freeze immediately on impact.

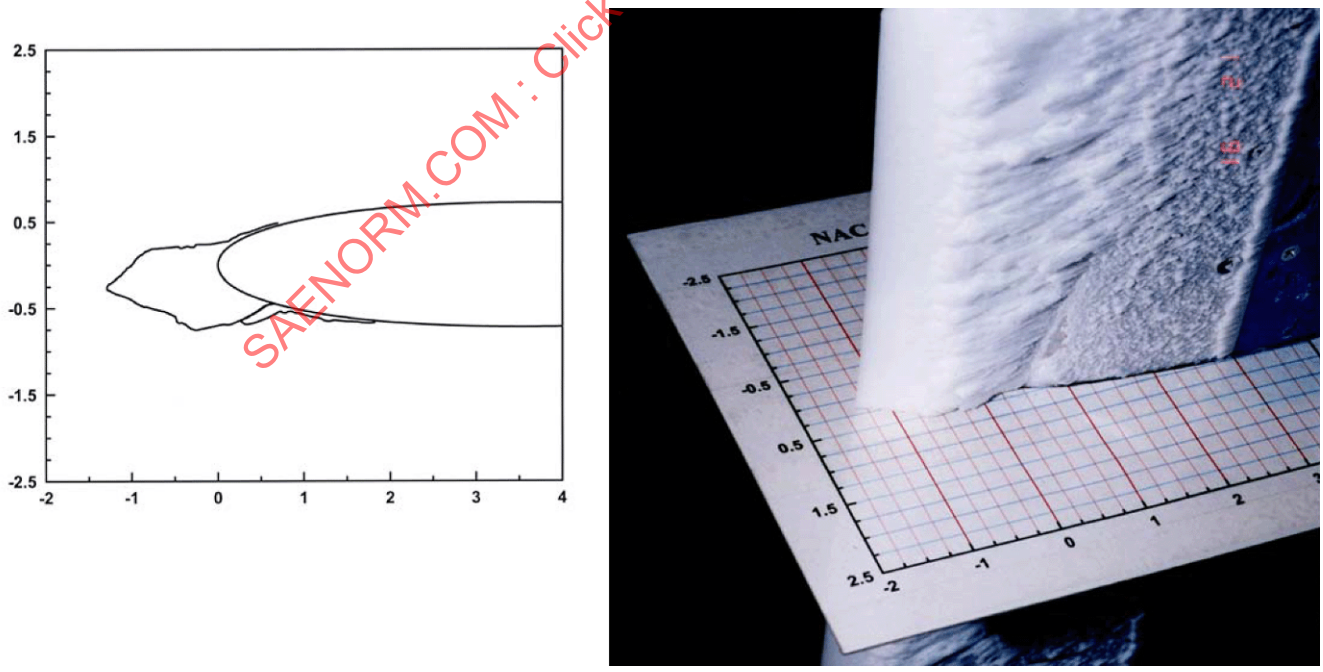


FIGURE 13 - Rime Ice Tracing and Photograph (of same ice accretion); Dimensions in Inches

4. (Continued):

RIVULET: A small stream of water.

ROTATING MULTICYLINDER: (1) An instrument consisting of a series of graduated cylinders possessing selective collection efficiencies (GM). (2) An instrument designed to determine SUPERCOOLED cloud LIQUID WATER CONTENT, droplet MEAN EFFECTIVE DIAMETER, and shape of the droplet size spectra. It consists of five or six stacked cylinders varying in diameter and rotating in the free air stream allowing ICE to accrete uniformly around each cylinder perimeter. In use since the 1940s, the rotating multicylinder method relies upon differences in COLLECTION EFFICIENCY among the graduated cylinders, and provides an accuracy within ±10% when carefully used.

ROUGHNESS ELEMENTS: A nominally hemispherical ICE feature. The experimentally measured diameters show an upper bound of about 2 mm.

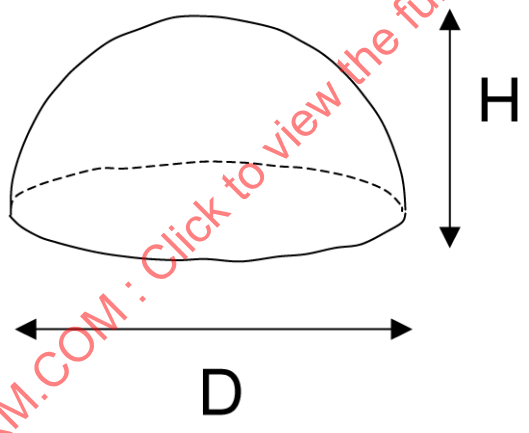


FIGURE 14 - Roughness Element; Maximum D ≈ 2 millimeters (mm), maximum H ≈ 1.5 mm

RUNBACK: Flow of liquid water downwind on a surface.

RUNBACK ICE: (1) ICE formed from the freezing or refreezing of water leaving electrothermally protected surfaces onto unprotected surfaces (FAAIH). (2) Ice formed from the freezing or refreezing of water leaving thermally protected surfaces onto unprotected surfaces (AS5498). (3) Ice accumulated aft of the protected region, resulting from the water running back and freezing (may be found with partially evaporative ANTI-ICING systems and with DEICING systems) (ADS-4).

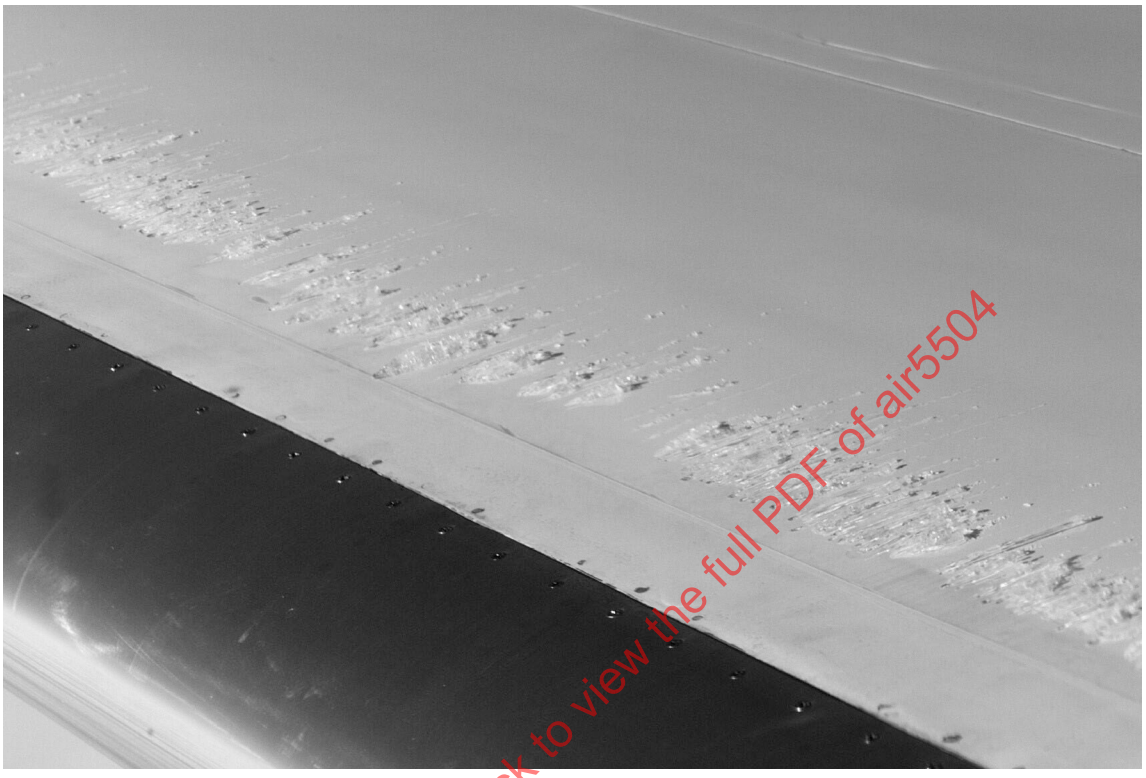


FIGURE 15 - Runback Ice

4. (Continued):

RUNBACK RIDGE: Water that has flowed aft on the airfoil to a specific region where conditions permit ICE formation. Predominately observed in conjunction with thermal ICE PROTECTION SYSTEM operation.

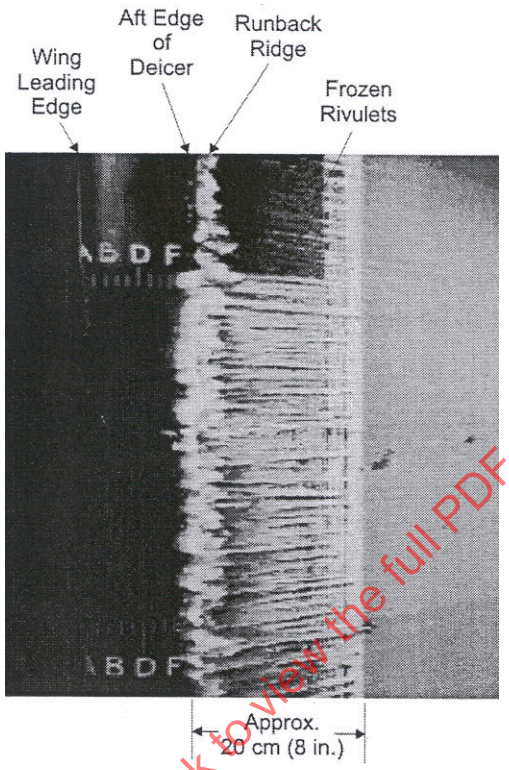


FIGURE 16 - Runback Ridge

4. (Continued):

RUNNING WET: (1) Defines heat requirements, either electrical or hot air for running wet ANTI-ICING that are based upon the maintenance of a surface temperature just above freezing, thus allowing some of the impinging water to run back and freeze aft of the heated area or off the surface (AIR1168/4). (2) A condition at which an airframe surface is maintained above 0 °C (32 °F) (by an anti-icing system) so that impinging water droplets will not freeze (ADS-4).

RUNNING-WET SYSTEM: Any ANTI-ICING system that supplies only enough heat to prevent impinging water droplets from freezing on the heated surface (FAAIH).

SAE: Society of Automotive Engineers

SANDGRAIN ICE: A thin layer of IMPACT ICE having a surface that approximately resembles that of rough grain sandpaper.