Results from Recent Research and Guidance for New Airplane Icing Certification Projects

Presented to: SAE 2007 Aircraft & Engine Icing International Conference

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Agenda

- Icing Tunnel Tests
- Propeller Icing Tests
- Guidance for Airplane Icing Certification Projects

Icing Tunnel Test

- **Why did we test?**
- **What did we test?**
- **What were the results?**

Icing Tunnel Test

- **Why did we test?**
- **Airworthiness Concern Sheet (ACS)**
  - Small Airplane Directorate process to communicate with public when considering Airworthiness Directive action
  - Issued December 22, 2004
  - Sent to AOPA for distribution to Pilots Association & NBAA, also posted on pilots' web site
  - Requested information on:
    - Operations – airspeed, boot activation
    - Airplane – performance, stall warning, boot operation
    - Weather planning strategies
    - Training

Icing Tunnel Test

- **Why did we test?**
- **Airworthiness Concern Sheet (ACS)**
  - Confirmed that boot activation procedures is an issue
  - Two respondents said ice shedding performance of pneumatic boots below 115 KIAS is poor
- **Review of certification data**
  - Certification data of one part 23 airplane, equipped with pneumatic boots, showed runback ice and significant performance penalties at total temperatures of 29-32 degrees F

Icing Tunnel Test

- **Why did we test?**
- **Review of accidents/events**

Altitude	OAT ºF	KCAS	Distance nm	Time min	KTAS	TTOT ºF
10000	24.7	175	54.1	16	203	34.5
18000	14.0	195	78.3	18	261	30.1
7000	17.0	180	8.2	2.5	196	26.0
4000	24.0	166	7.2	2.5	172	31.0
17000	24.8	150	10.0	3	200	34.3
800	30.2	90	5.9	4	88	32.0
1600	28.4	90	6.0	4	90	30.3

- **AIAA 2006-82-502 – "The surface weather observation at the time of an icing event will typically exhibit temperatures which average between -2.5ºC and 1.75ºC**

Icing Tunnel Test

- **What did we test?**
- **Objectives for May 2005 Test**
  - Low airspeed boot performance
  - Boot activation procedures
  - Warm temperature
  - Impingement with large drops
  - Ice adhesion inhibitors
  - Takeoff ice accretion
- **Test Article**
  - Hybrid model used in 2000 FAA/NASA/Goodrich Research
  - Full scale 23012 leading edge
  - Goodrich type 29S deicing boot at 18 psig, tapered edge
  - Inflation/deflation rates matched to airplane data

Icing Tunnel Test

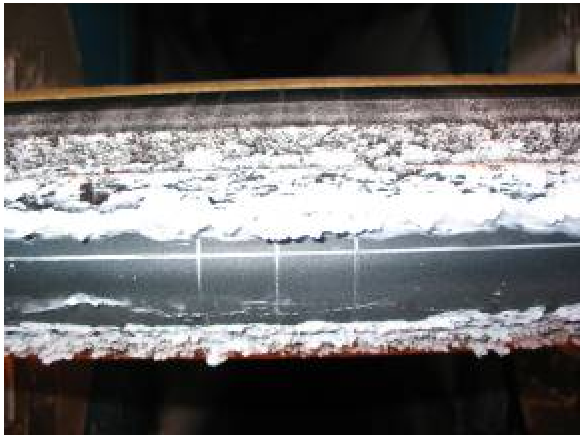
- **Test Results – shedding**
  - Icing conditions: 14ºF, 17 μm, .53 g/m^3

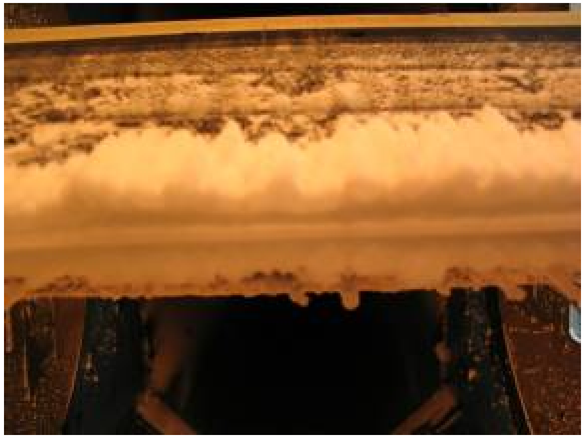
	Manual Cycling		Simulated Automatic Cycling	
KTAS	¼ inch	¾ inch	1 minute	3 minute
171	Clean shed at 7:45 (5), shed at 17:50 (12), large feathers self shed at 19:00	Partial sheds at 7;30 (1), 15:00 (2), and 23:00 (3)		20 psig: Clean sheds at 3:00 (1) and 9:00 (3)
137	Clean shed at 21:00 (6)	Clean shed at 39:00 (6)		
120	Good shed at 38:50 (26)	Clean shed at 44:00 (7)		
103	Good shed at 20:00 (12)	No shed up to 30:00 (10)	Good shed by 15:00 (15), clean shed at 33:00 (33)	

Icing Tunnel Test

- **Test results - shedding**
  - Icing conditions: 6ºF, 19 μm, .45 g/m³

	Manual Cycling		Simulated Automatic Cycling	
KTAS	**¼ inch**	**¾ inch**	**1 minute**	**3 minute**
120	**Good sheds at 13:00 (4) and 25:25 (11)**	**No good sheds up to 29:00 (3)**	**Partial shed at 8:00 (8), clean shed by 23:00 (23)**	**Good shed at 25:00 (8)**

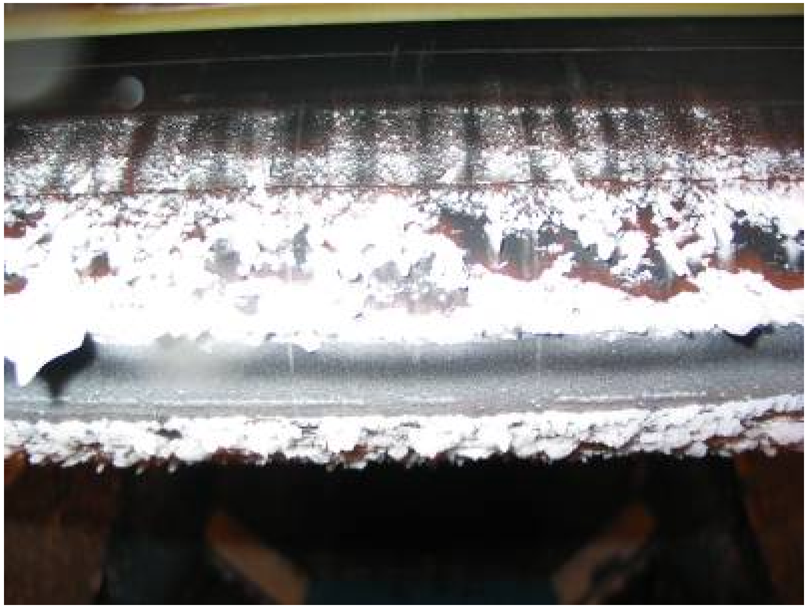




Icing Tunnel Test

- **Test results – residual ice**
  - Icing conditions: 14ºF, 17 μm, .53 g/m^3, 137 KTAS

¼ inch cycling



¾ inch cycling

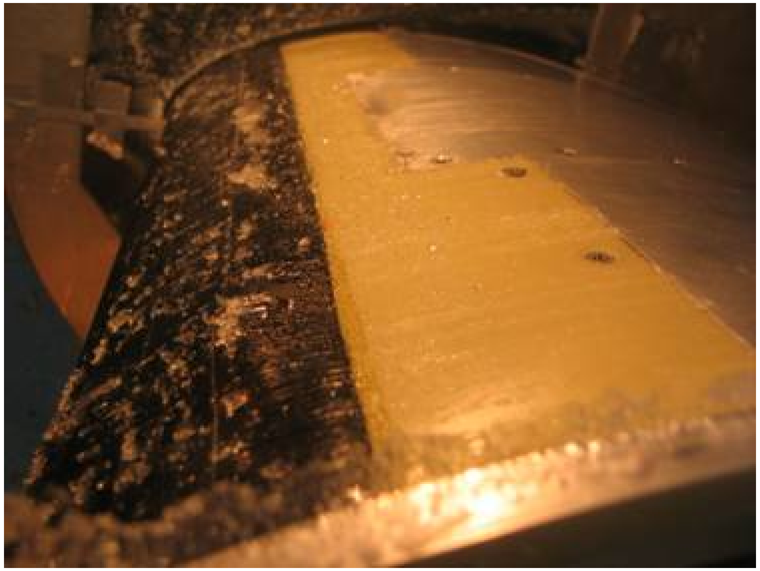
Icing Tunnel Test

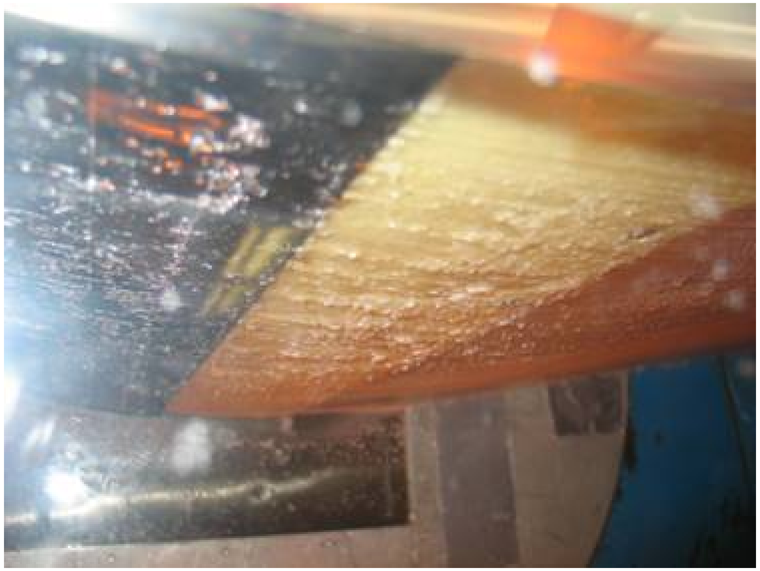
- **Test results – runback ice**
  - Icing conditions: MVD = 20 μm, LWC = .59 g/m^3

KTAS	AOA	OAT, °F	Total Temperature, °F
159	1.5	25.0	31.0
137	4.4	26.5	31.0
111	6.7	26.5	29.4

Icing Tunnel Test

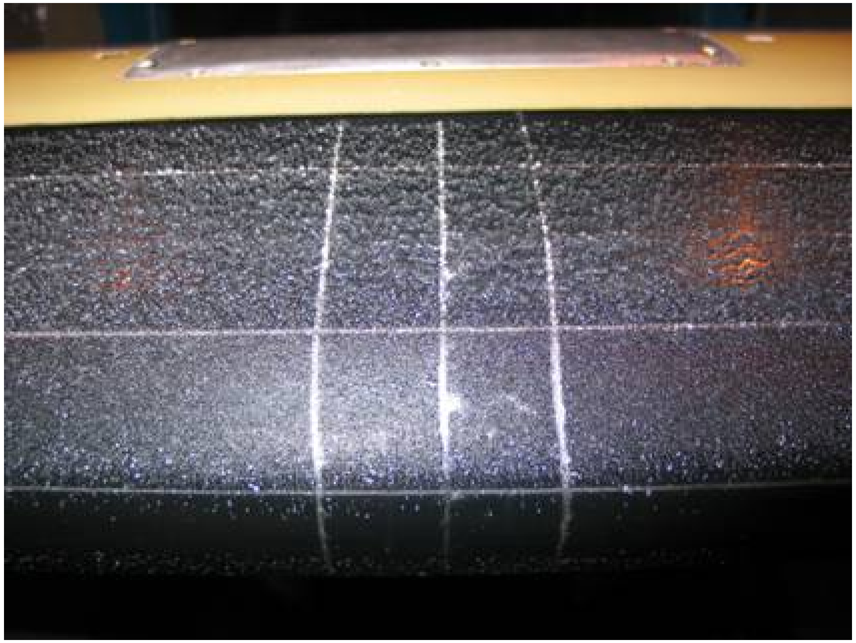
- **Test results – runback ice**

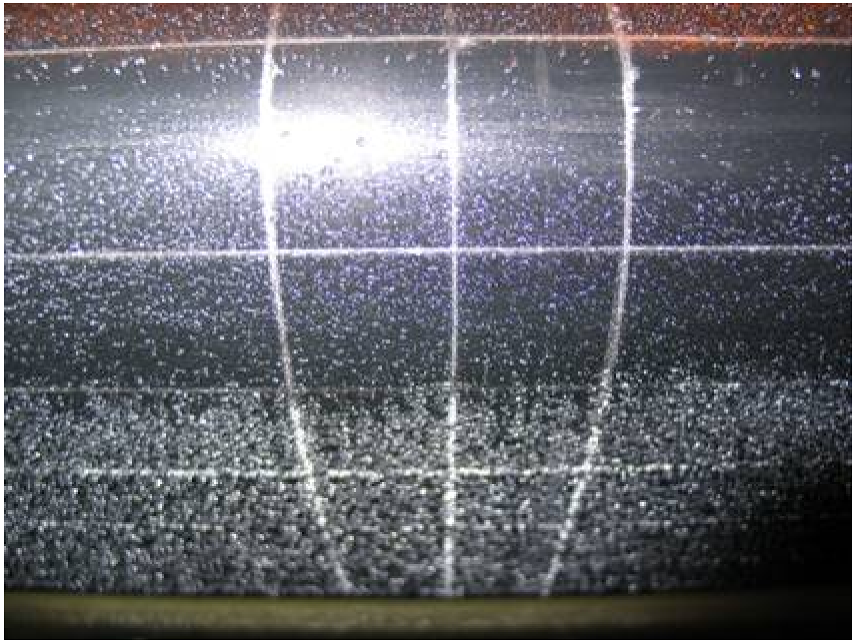




Icing Tunnel Test

- **Test results – large drop within Appendix C**
  - 50µm MVD   18.0°F OAT   120 KTAS 4.4 AOA   0.88 LWC   27 sec
  - Reference: 0.32 LWC   74 sec





Icing Tunnel Test

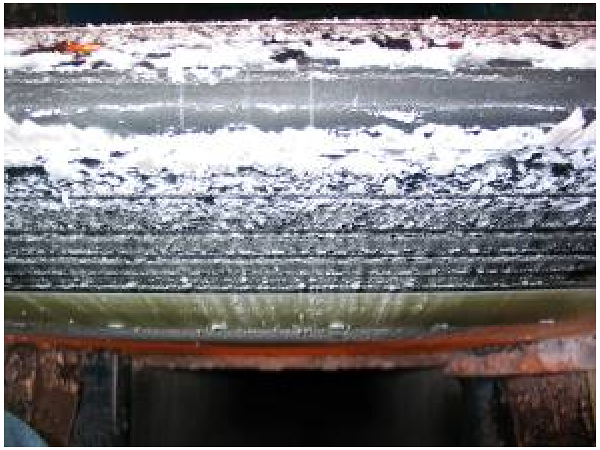
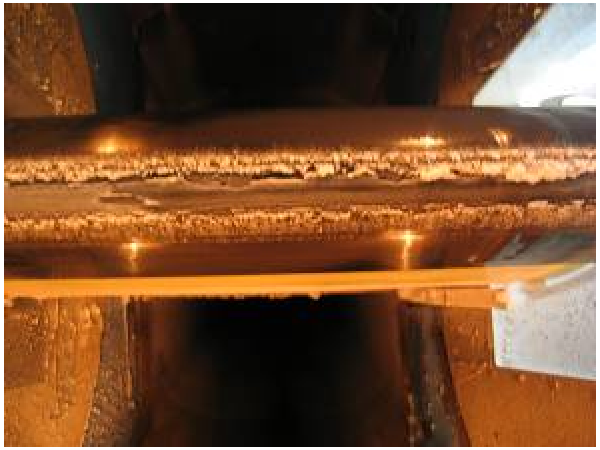
- **Test results – ice adhesion inhibitor**

	Manual Cycling		Simulated Automatic Cycling	
	¼ inch	¾ inch	1 minute	3 minute
17µ MVD 14°F OAT 0.53 LWC 120 KTAS				
Clean Boot	Good shed at 38:50 (26)	Clean shed at 44:00 (7)		
ICEX	Clean shed at 9:00 (2)			
19µ MVD 6°F OAT 0.45 LWC 120 KTAS				
Clean Boot	Good sheds at 13:00 (4) and 25:25 (11)	No good sheds up to 29:00 (3)	Partial shed at 8:00 (8), clean shed by 23:00 (23)	Good shed at 25:00 (8)
ICEX	Clean sheds at 10:45 (3) and 25:00 (7)		Clean sheds at 4:30 (4), 8:00 (8) and 19:00 (19)	

Icing Tunnel Test

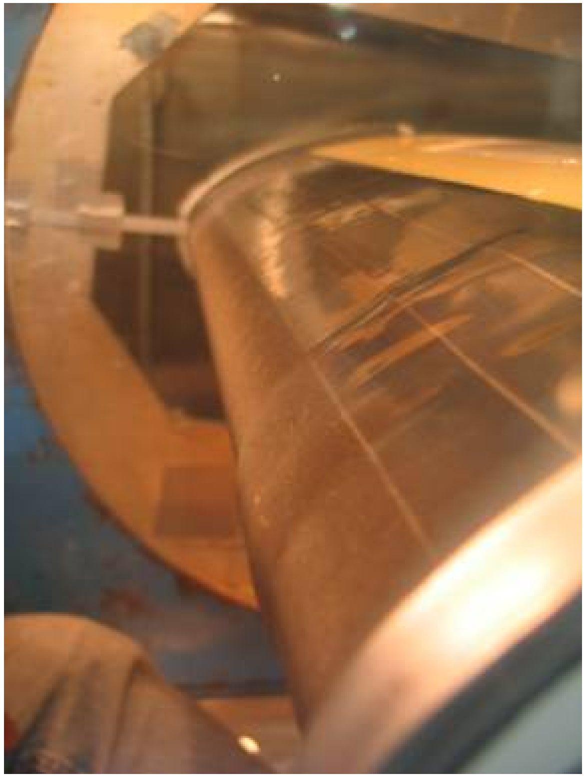
- **Test results – ice adhesion inhibitor**

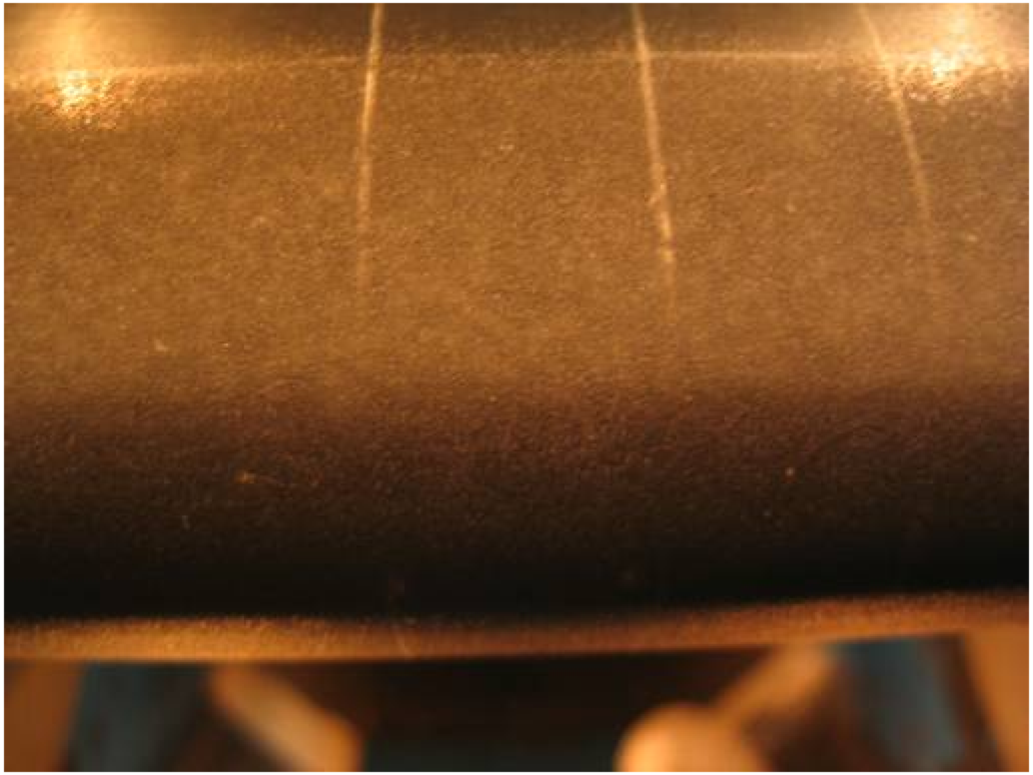


Icing Tunnel Test

- **Test results – takeoff ice accretion**
  - 20μm MVD   16.0°F OAT   0.35 LWC
    - 0-134 KTAS -0.5º AOA 26 sec
    - 134 KTAS   6.7º AOA 34 sec





Icing Tunnel Test

- **What did we test?**
- **Objectives for August 2007 Test**
  - Effect of airspeed & AOA on runback ice
  - Effect of boot installation type
  - Boot shedding performance at intermediate speed
  - Ice adhesion inhibitors
- **Test Article**
  - Hybrid model used in 2000 FAA/NASA/Goodrich Research
  - Full scale 23012 leading edge
  - Goodrich type 29S deicing boot at 18 psig, tapered edge
  - Inflation/deflation rates matched to airplane data

Icing Tunnel Test

- **Boot installation types**

2000 Test

2005 Test

Icing Tunnel Test

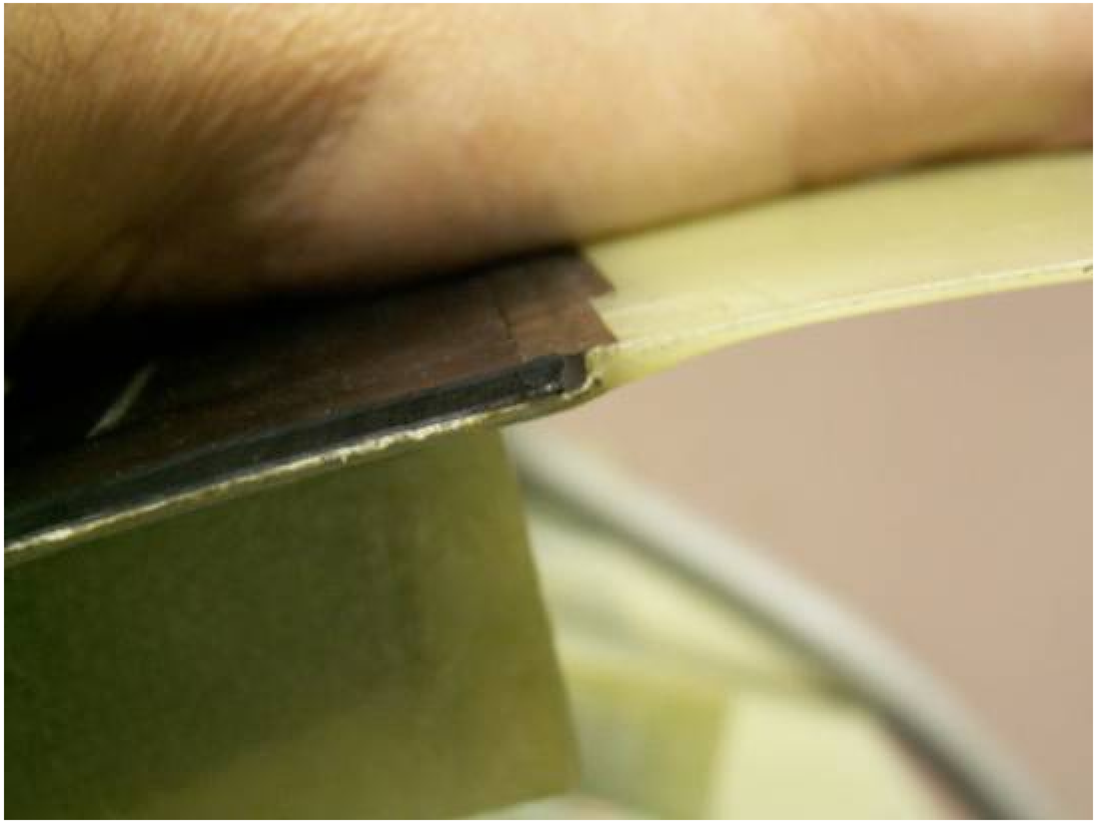
- **Boot installation types**

In service

2007 Test

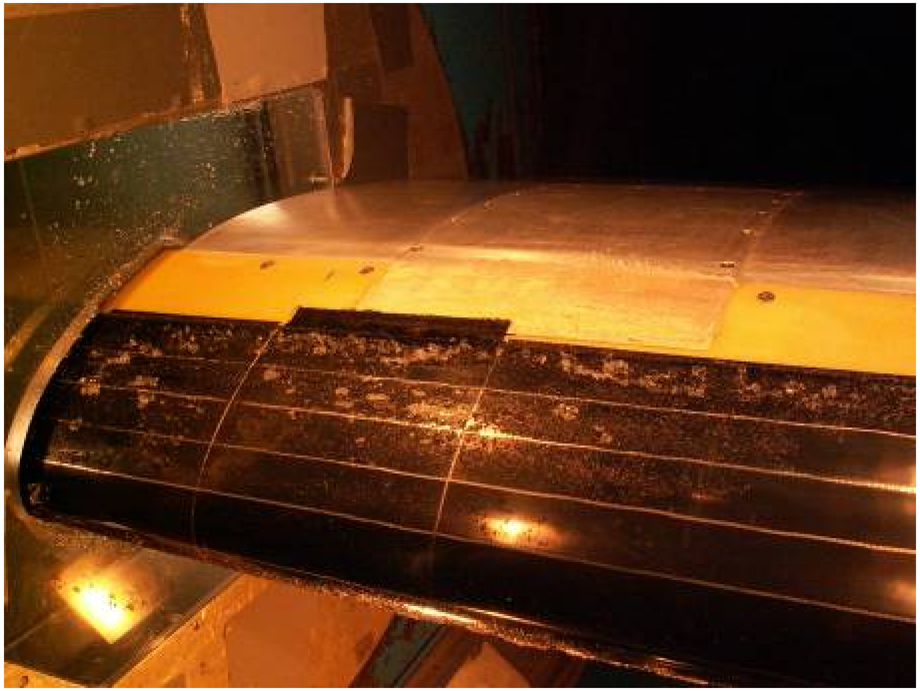
Icing Tunnel Test

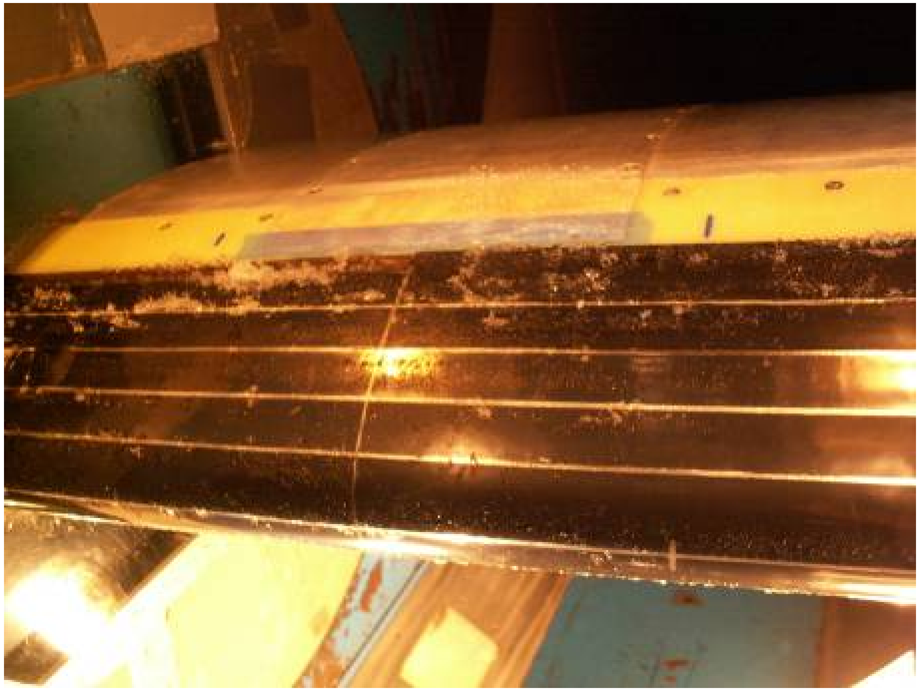
- **Boot installation types**
  - Minimum recess gap plus conductive edge sealer



Icing Tunnel Test

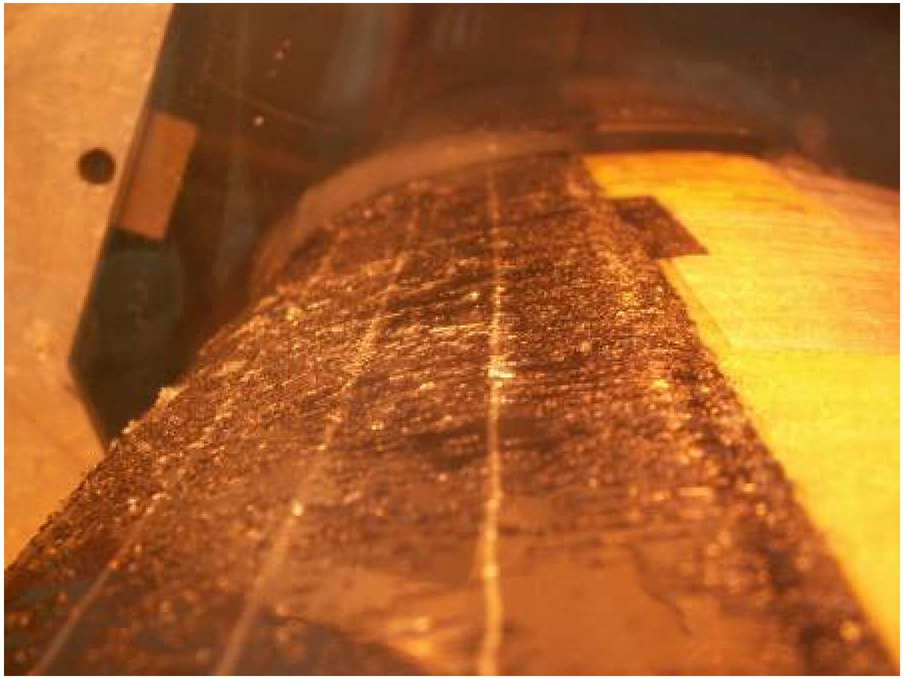
- **Test results – effect of boot installation type**
  - 170 KTAS 0 AOA 0.31 LWC 30 MVD 32.0 TTOT
    - Tapered: 0.17“ inactive area
    - Recessed small gap: 0.30 “
    - Recessed large gap: 0.33 “

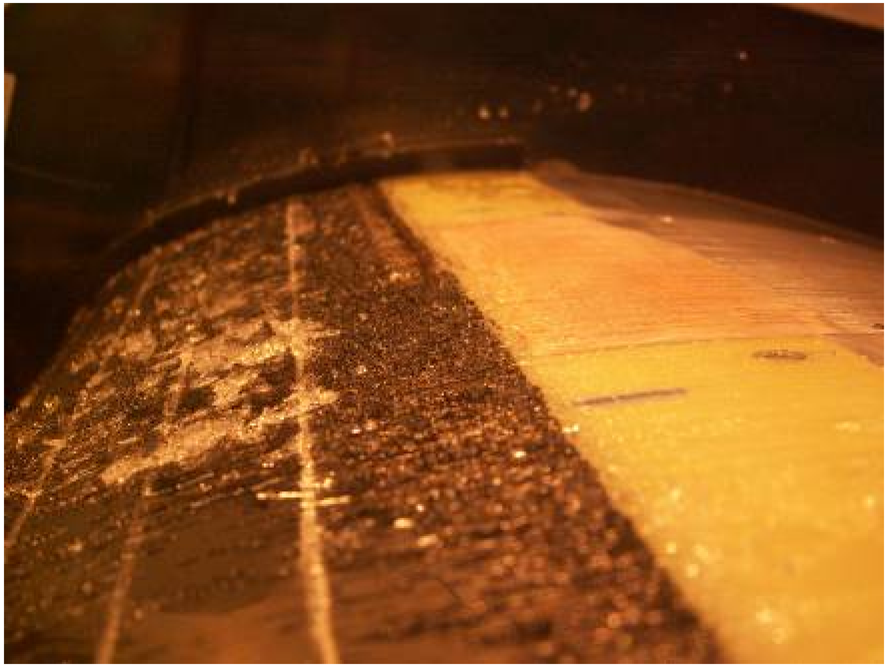




Icing Tunnel Test

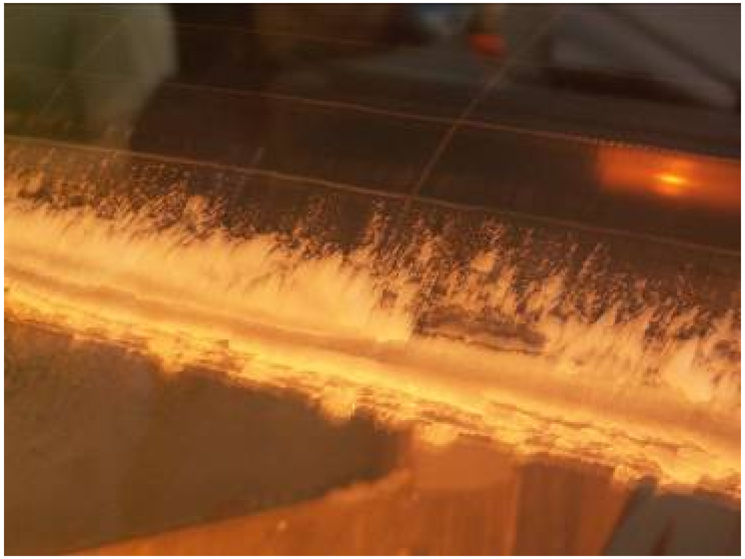
- **Test results – effect of boot installation type**
  - 106 KTAS 4.4 AOA 0.46 LWC 25 MVD 31.7 TTOT
    - Tapered: 0.025“ inactive area
    - Recessed small gap: 0.05-0.09 “
    - Recessed large gap: 0.05-.11 “ (rougher behind boot)





Icing Tunnel Test

- **Test results – boot performance at intermediate airspeed (150 KCAS)**

OAT / LWC / MVD	Automatic Cycling
ºF / g/m^3 / μm	1 minute
14ºF / 0.53 / 17	Boot activation at 1:00, some feathers aft of ice cap shed at 8:00 (8), partial sheds of ice cap at 11:00 (11), 12:00 (12), and 16:00 (16).
21ºF / 0.61 / 17	Similar result 

Icing Tunnel Test

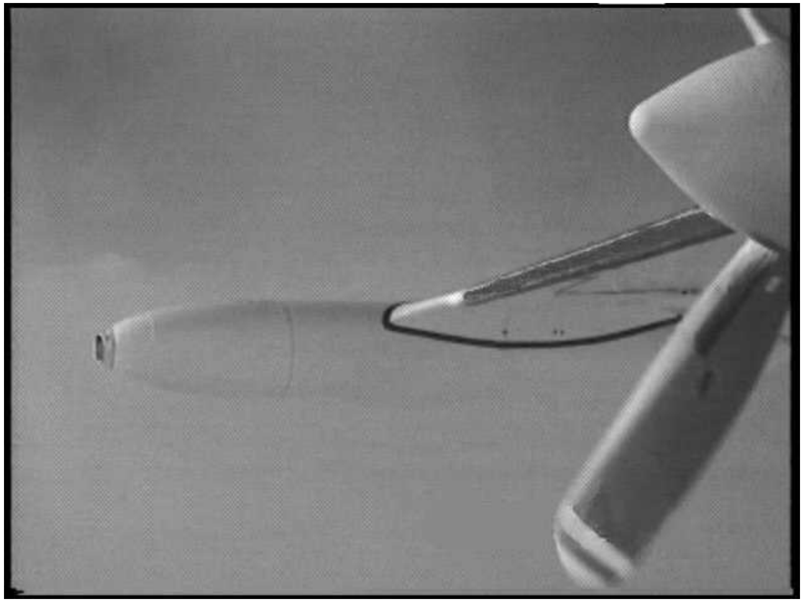
- **Test results**
  - FAA Technical Center Reports planned for both the 2005 and 2007 tests
  - AIAA 2007-1090 “Residual and Inter-cycle Ice for Lower-Speed Aircraft with Pneumatic Boots” summarizes some 2005 test results

Propeller Icing Test

- **Why did we test?**
- **What did we test?**
- **What were the results?**

Propeller Icing Test

- Why did we test?



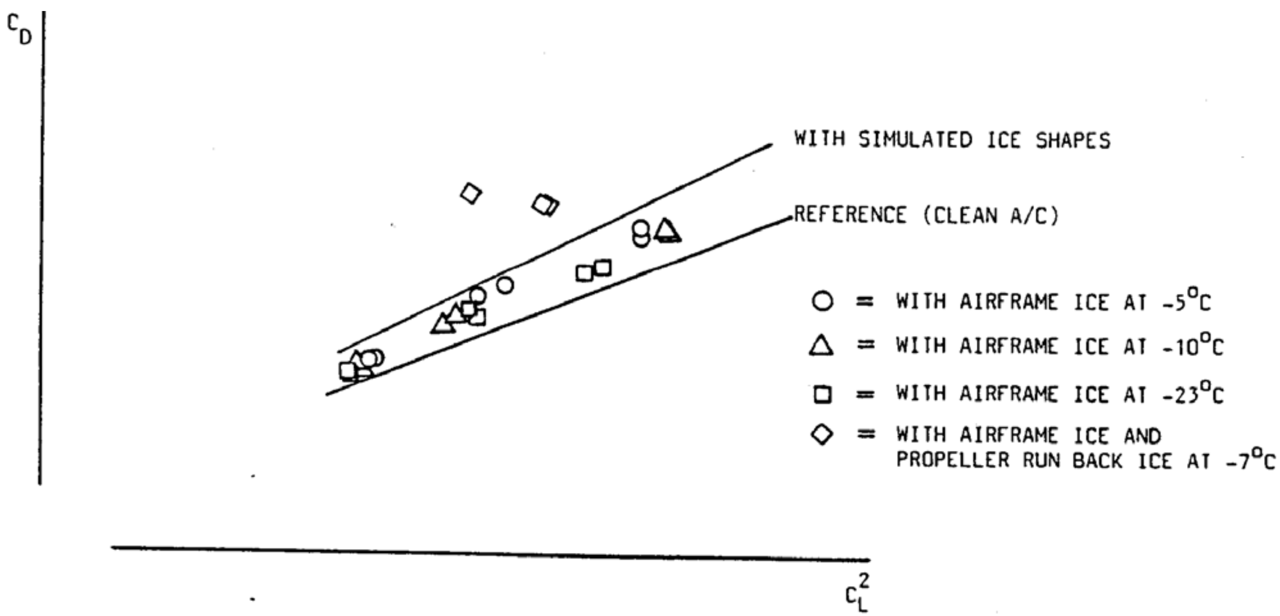
- 50 knot loss in airspeed in 85 seconds in MU-2 suspected SLD encounter at 16,100 ft., 237 KTAS, 12ºC OAT
- Estimated 19.4% drop in propeller efficiency due to ice

Propeller Icing Test

- **Why did we test?**
  - Operational and flight test experience of a regional turboprop airplane
    - Powered by two engines, 4 bladed, 11 ft. diameter composite blade propellers
    - Winter 1984-1985
      - "Unable to climb above 12,000 ft."
      - "Aircraft decelerated in level flight and we had to descend to avoid stalling"
  - Airplane manufacturer initiated two tests
    - Ice shapes to simulate full span leading edge accretion on full scale propeller blades in RAE Farnborough wind tunnel
    - Natural icing flight tests

Propeller Icing Test

- **Why did we test?**
  - Quantitative performance in measured, natural icing flight tests showed discrepancy around -7ºC
  - Photos showed runback ice behind prop heaters on both sides of blades



Propeller Icing Test

- **Why did we test?**
  - Propeller wind tunnel tests

Ice shapes	Drop in efficiency
Leading edge shapes alone	5.5%
Small ridges of residual ice after leading edge shed	9%
Leading edge squared and serrated and runback shapes	20%
Same as above but grooved runback shapes	17%
Same as above but remove leading shapes from outer 33% span	Slight increase
1 mm grit sandpaper over first 30mm chord	3%

Propeller Icing Test

- **Why did we test?**
  - Natural icing flight tests
    - Natural icing flight tests repeated
      - Eight different deicing schedules tested
      - Deice cycle changed from 90/90 to 10/90 above -13º
        - » Prop deice not required above -5ºC
        - » NORM mode between -5ºC and -13ºC
        - » HIGH mode below -13ºC

    - Reference: *Experience from a Propeller Icing Certification*, paper presented to SAE AC-9C Aircraft Icing Technology Subcommittee, September 18-22, 1989

Propeller Icing Test

- **Why did we test?**
  - Certification experience of other turboprop manufacturers
    - Another airplane incorporates a cockpit switch that changes the deice “on” time
      - AFM procedure based on OAT
    - Another turboprop airplane AFM:
      - In climb or cruise, propeller icing may cause a significant decrease in indicated airspeed or climb rate, even though ice accretion on the airframe may be relatively light. At constant power an airspeed loss up to 25 knots is normal.
  - Documentation of runback ice after landing from turboprops in service
  - Propeller efficiency losses can be significant for smaller airplanes
    - Some single engine airplanes approved for known icing have service ceilings with critical ice accretions less than some MEA’s in the western U.S.
  - Historically propeller performance has not been quantified in airplane certification programs

Propeller Icing Test

- **What did we test?**
  - Document propeller ice accretions in Appendix C icing conditions
    - Leading edge accretion
      - Size and shape, span location, shedding frequency
      - Function of RPM, icing condition, blade material, blade condition
      - Erosion strips?
    - Runback ice accretion
      - Size, shape and location
      - Function of icing condition, deicing schedules and power, blade material, RPM
  - Document propeller ice accretions in large drop icing conditions
    - Determine if MU-2 propeller ice accretion can be duplicated
  - Measure difference in thrust between non-iced and iced propeller
  - Evaluate differences between reference and scaled conditions
  - Determine if nominal propeller efficiencies can be proposed for certification

Propeller Icing Test

- **What did we test?**

Engine	Maximum Prop RPM	Propeller Blades	Deicing Schedule
TIO-540-J2BD	2500	2-aluminum	90/90
		3-composite	90/90
		4-composite	90/90; continuous
TPE331-10-511M	1591	4- aluminum	34/34/68; 10/60; 20/60; 90/90
		5- composite	continuous

Propeller Icing Test

- **What did we test?**
  - TPE331 turboprop engine tested (1590 RPM) at Eglin AFB in November 2006
    - New and in service aluminum blades
    - Composite and aluminum blades
    - Three different deicing systems
    - Test velocity 100 KCAS
    - Several Appendix C conditions tested
    - Two SLD conditions tested
      - 96 µm MVD, 0.36 g/m^3 LWC, 12ºF and 24ºF
  - Collaborative effort with AF, Goodrich, NASA, Industry
  - 26 test runs completed over 6 days
  - Data consisted of video, photos, tracings, thrust. blade angle, engine parameters

Propeller Icing Test

- **What did we test?**

Propeller Icing Test

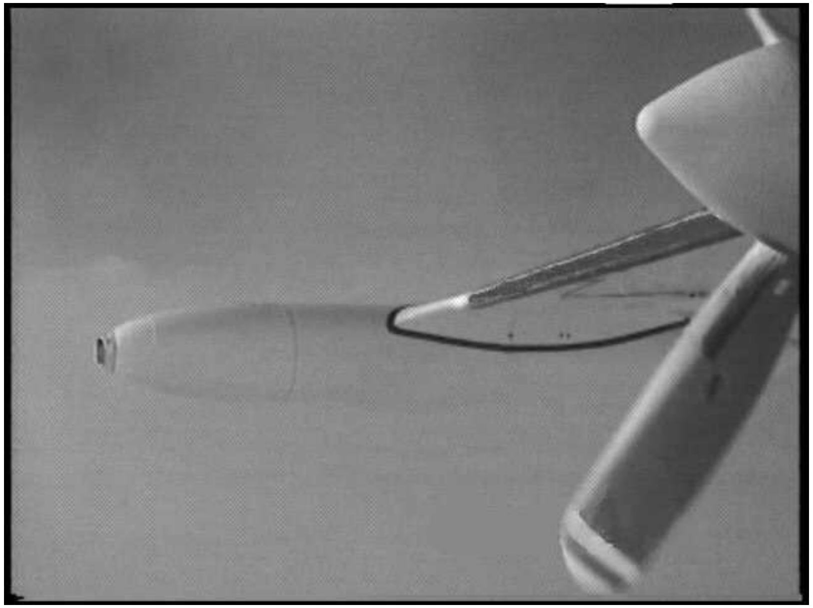
- **Open-jet set-up considerations**
  - Drop-off of centerline velocity and uniformity of flow
    - Propeller tips to stay in core flow region
    - Outside of core flow, lower velocity and cloud expansion
    - Propeller 30 feet from nozzles, 9 feet from end of 10 feet diameter open jet for 8 feet diameter propeller
  - Capture diameter at higher power
    - Testing without open-jet extension had been considered
- **Calibration of open-jet plume**
  - LWC-MVD map created
  - Johnson William LWC probe
  - Malvern (beads, NASA IRT)
  - Grid
  - Velocity profile across span

Propeller Icing Test

- **Scaling**
  - Full scale propeller
    - Adhesion of ice
    - Ice shedding function of centrifugal
  - Open jet velocity 105 KTAS
    - Reference velocities 135 to 240 KTAS
  - Three reference blade radii
    - 75% and 50% radius
      - Based on scaling methods for unprotected fixed wings
      - $\beta_o \rightarrow$ MVD, $n_o \rightarrow$ OAT, $A_C \rightarrow$ time
    - Mid-span deicing boot
      - Thermal scaling approach recently developed for an wing anti-ice system

Propeller Icing Test

- **What were the results?**



Propeller Icing Test

- **What were the results?**
  - Initial cruise power, spray for average 12 min, 34/34/68
    - SLD
      - Blade angle decreased 2.3º @ 12ºF, 1.2º @ 24ºF
      - Measured thrust decreased 480 lb. @ 12ºF, 200 lb. @ 24ºF
    - Appendix C Continuous Maximum
      - Blade angle decreased 0 – 0.2º
      - Measured thrust decreased 150 - 200 lb.
    - Appendix C 40 MVD Intermittent Maximum (1 min spray time)
      - Blade angle decreased 0º
      - Measured thrust decreased 10 lb.
    - The 90/90 and continuous heat deicers had reduced blade angle and thrust decrements
    - Initial thrust loss unexplained

Propeller Icing Test

- **What were the results?**
  – Thrust loss at maximum power, accounting for ice stand drag

Deicer	SLD 12ºF	SLD 24ºF	Appendix C
34/34/68	19.6%	9.7%	3.1%
Continuous		12.0%	14.0%
90/90	13.3%		7.4%

Propeller Icing Test

- **Test results**
  - FAA Technical Center Reports planned
    - DVD with video, photos, tracings, data for each run
    - Summary of thickness measurements
  - AIAA 2008

Guidance for New Icing Certification Projects

Guidance for New Icing Certification Projects

- Ice Protection System Activation
- Critical Ice Accretions on Protected Surfaces
- Stall Warning
- Airplane Performance
- Takeoff Ice Accretions
- Engine Considerations
- Ground Deicing Fluids

Boot Activation Procedures

- **Flight testing and icing tunnel testing of "modern" boots showed deicing boots can be activated at first sign of ice accretion.**
  - Boot performance is airspeed dependent
- **The recommended AFM procedure for boot operation should be to operate the boots in an appropriate continuous mode at the first sign of ice and not to wait for a specific amount of ice to accumulate.**

Boot Activation Procedures

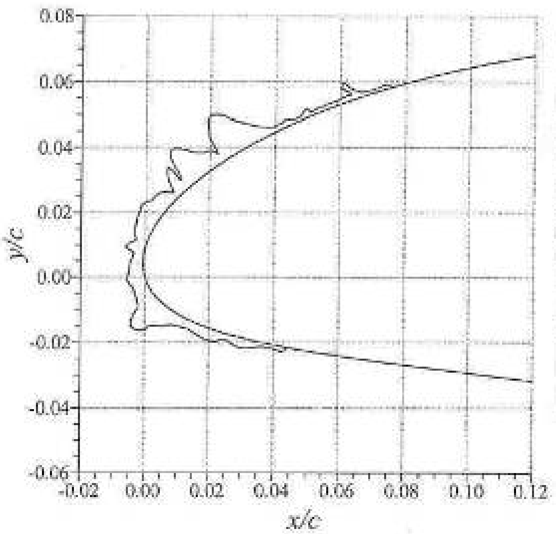
- **Recent certifications:**
  - Determining a specific ice accretion thickness is difficult
    - Adopted AFM boot activation at first sign of ice accretion
  - Manual boot operation results in high workload
    - Adopted timer for automatic boot cycles
  - 3 minute boot cycle mode results in large intercycle ice accretion and determining whether to use 1 or 3 minute mode adds to workload

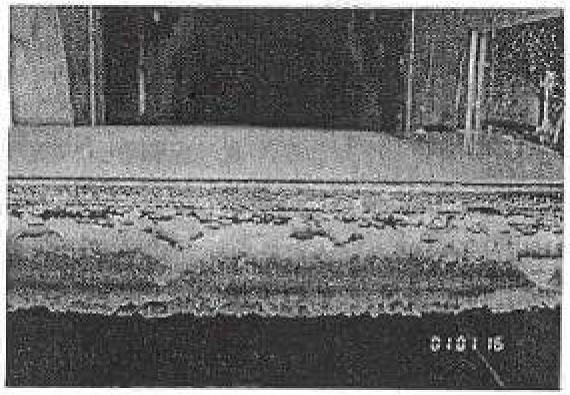
Ice Protection System Activation

- **Fluid freezing point depressant systems**
  - Pre-activation ice is critical
    - After two minute delayed activation, it may take several more minutes to completely shed ice

Critical Ice Accretions

- Intercycle and residual ice
  - Should be empirically determined
  - Intercycle ice significant
  - Ice may accrete over numerous deicing boot cycles below 160 KCAS
- Cannot use ice adhesion inhibitors for certification





Critical Ice Accretions

- **Runback ice**
  - Applicants should determine if runback ice accretions could occur on their airplanes in warm Appendix C icing conditions. If runback ice accretions can occur within Appendix C conditions, they must be considered when determining critical ice accretions for performance, stall characteristics, stall warning, and controllability.
  - Data should be obtained at the following conditions, as a minimum:
    - LWC (liquid water content) at maximum part 25, Appendix C value;
    - MVD (median volumetric diameter) anywhere within part 25, Appendix C conditions;
    - outside air temperatures of 24º to 28ºF;
    - total air temperatures of 29º to 34ºF
    - airspeeds from minimum holding in icing to maximum expected holding airspeeds

Critical Ice Accretion

- **Runback ice**
  - Will form on electro-thermal deicing systems
  - Empirical tests needed to define protected surface ice accretions

Critical Ice Accretions

- **Large drop within Appendix C (AC 20-73A)**
  - Since drops larger than the MVD exist, consider using the Langmuir D distribution with the 50 μm maximum median drop diameter of 14 CFR part 25 Appendix C to determine impingement limits.
  - If you fail to consider drop diameters larger than the maximum mean value and ignore water catch below a selected local water catch efficiency (β) (for example, 0.10), you may be ignoring the buildup of thin, rough ice at the impingement limits that may cause adverse aerodynamic effects.
  - Applicants should provide:
    - Justification when selecting local water catch efficiencies other than zero for the impingement limits.
    - Justification when choosing not to consider the drop spectrum around a median diameter of 50 μm for determining the chordwise extent of the ice protection surface
      - It is possible that 40 μm may result in more roughness due to short exposure time of 50 μm

Natural Icing Flight Test Matrix

Configuration	Ice Accretion	Trim Speed	Maneuver
Flaps up, gear up	Equivalent to 45-minute hold at critical conditions	Minimum Holding	•Level, 40-degree banked turns •Bank-to-bank rapid rolls, 30 degrees – 30 degrees •Climb or level performance evaluation •Autopilot tests •Straight stall
Landing flaps, gear down	1.25 inches on unprotected part of wing tip	Vref	
Flaps up, gear up	Defined pre-activation ice	Optional	

Stall Warning

- **Adequate stall warning with critical ice accretions**
  - Study of icing events shows we have to do this right in certification
  - Means in icing same as in non-icing
    - No credit for buffet if airplane equipped with stall warning system
  - Margin adequate
    - Production tolerances
    - Single vane systems
  - Test procedures

Stall Warning

- **Test Procedures**
  - Deceleration rate
    - Slower than one knot per second?
  - Coordination
    - "Seat of pants" and ball versus flight test sideslip indicator

Stall Warning

- **Stall Recovery**
  - Training versus certification
    - ATP and type rating requirements emphasize “approach to stall”
      - Recovery at first indication of impending stall (stall warning)
      - “Recovers to a reference airspeed, altitude and heading with minimal loss of altitude, airspeed, and heading deviation.”
        - » Assumes airplane always has excess thrust to counter drag
        - » Assumes airplane will never require a technique that trades altitude for airspeed
        - » May have been a factor in events
        - » Commercial and Business Aviation Advisory Circular No. 0247 August 24, 2005
    - ATP recovery procedure should be evaluated with critical ice shapes.

Airplane Performance

- **Added to AC 23.1419-2D:**
  - Use a propeller efficiency loss of 10% to calculate airplane performance in icing unless another value can be substantiated.
  - If service ceiling in icing is less than 22,000 ft., AFM performance section should include enroute climb performance with critical ice accretions in same format as the non-ice data.
    - Both part 23 and 25 regulations address takeoff, approach and balked landing climb gradients

Takeoff Ice Accretions

- **Takeoff with a contaminated wing**
- **Ice accretion after lift-off**

Leading Edge/Upper Surface Wing Contamination

- Small, almost visually imperceptible, amounts of ice on the wing's leading edge or upper surface can cause severe aerodynamic penalties and result in a loss of control during takeoff.
- Despite operating rules, procedures, and training programs stressing the importance of a clean wing for takeoff, continued accidents and incidents show that airplanes are still departing with ice-contaminated wings.
- Manufacturers of transport and commuter category, and part 23 turbojet airplanes, that do not have leading edge high lift devices requested to:
  - Show adequate safety margins exist when taking off with small amounts of wing contamination on the wing leading edge or upper surface and that such a procedure is feasible; or
  - Include an AFM Limitation statement prohibiting takeoff with frost, ice, snow, or slush adhering to any critical surface, and requiring a visual and tactile check of the wing leading edges and upper surfaces before takeoff whenever conditions conducive to ground icing are present.

Engine Considerations

- **Engine ice protection at flight idle**
  - Minimum throttle position to maintain ice protection not acceptable for engine ice protection
    - Had been part 25 policy, now part 23 policy
- **Ice shedding**
  - Engines close behind forward ice accretion sites on many light jet designs
    - Inboard wing unprotected area
    - Radome
    - Periodic shedding from inboard wing deicing system
    - Cold soaked fuel

Ground Deicing Fluids

- **Guidance added to AC 23.1419-2D**
  - Describes performance and controllability issues listed in AC 135-16
  - Effect of thicker fluids need to be flight tested on airplanes with reversible controls and low takeoff rotation speeds
    - Summarizes past methods used by airplane manufacturers
    - SAE G-12 Aerodynamics Subgroup developing standards
  - Design considerations
    - Drain holes
    - Minimize quiet areas
    - AFM Limitations

AFM Limitations on Severe Icing

- **AD**
  - WARNING

    Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.
  - During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.
  - Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
  - Accumulation of ice on the lower surface of the wing aft of the protected area.
  - Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.

AFM Limitations on Severe Icing

- **AC 23.1419-2A:**

1. LIMITATIONS SECTION. In the case of severe icing, the following text and warning information should be used as in the Limitations Section of the AFM:
a. Flight in meteorological conditions described as freezing rain or freezing drizzle, as determined by the following visual cues, is prohibited:
(1) Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.
(2) Accumulation of ice on the upper surface (for low-wing airplanes) or lower surface (for high-wing airplanes) of the wing aft of the protected area.
(3) Accumulation of ice on the propeller spinner farther back than normally observed.
If the airplane encounters conditions that are determined to contain freezing rain or freezing drizzle, the pilot must immediately exit the freezing rain or freezing drizzle conditions by changing altitude or course.
NOTE: The prohibition on flight in freezing rain or freezing drizzle is not intended to prohibit purely inadvertent encounters with the specified meteorological conditions; however, pilots should make all reasonable efforts to avoid such encounters and must immediately exit the conditions if they are encountered.
b. Use of the autopilot is prohibited when any ice is observed forming aft of the protected surfaces of the wing, or when unusual lateral trim requirements or autopilot trim warnings are encountered.

Rotorcraft Directorate Icing Activities

- **Support Rotorcraft Icing Certifications for Flight Into Known Icing (FIKI)**
  - Eurocopter EC225LP U.S. Validation in-work.
  - Sikorsky S-76D Certification in-work.
  - Agusta Westland AW139 Approval for FIKI
- **Develop Revised Icing Guidance**
  - Working with SAE AC9C technical committee to develop recommended icing guidance changes to AC27-1 & 29-2.
    - ✓ First meeting held 4/15-18/ 2007 in Toronto, Canada.
    - ✓ Next meeting 9/28/07 in Seville, Spain.
- **Develop rulemaking to adequately address SLD icing environment.**
  - Rotorcraft Directorate intends to follow the Part 25/33 rulemaking on SLD.
- **Work with industry to define rotorcraft icing R& D activities.**