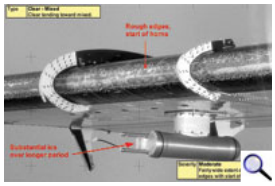
PROFESSIONAL PILOT

AIR SAFETY

Shedding the hoary myth of ice bridging

NTSB advises immediate activation of deice boots on entering icing conditions.

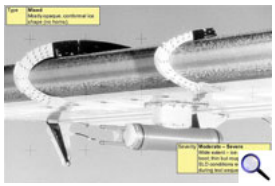


Example of a thin, rough clear-mixed ice accumulation obtained in flight during NASA research. This type of rough ice can have severe performance penalties, and it is difficult to estimate its thickness. Compare this image with the one on the right.

Immediately after the flightcrew exited the airplane, the customer service agent asked them what had happened. They replied that they believed they'd encountered windshear when they came across the tree line on the approach to Runway 16.

They said, "It was like the bottom just fell out on us." The ATC tower controller witnessed the event and stated that the Citation appeared to touch down hard and on its right wing. When he asked the pilot if everything was all right, the pilot replied, "I believe so" and stated that they had experienced windshear on final.

The same controller said he queried the crew of a Bombardier Challenger that landed on Rwy 16 just after the mishap if they had experienced any windshear. They said they had not. Later, the pilot told investigators that he had heard about "ice bridging" during training.



Mixed rough ice accumulation obtained in flight during NASA research. Note the extent of coverage, extending near the limits of deice boot coverage. NASA icing training products (available at aircrafticing.grc.nasa.gov/courses.html) contain further examples.

The copilot stated that the deice boots should not be activated "unless you have 1/4-1/2 inch of ice." A review of Cessna's Citation 500 operating manual revealed that it did in fact advise pilots to wait for the ice to build to 1/4-1/2 inch before inflating the pneumatic deice boots.

It also stated, "Early activation of the boots may result in ice bridging on the wing." Similarly, the Citation 560 aircraft flight manual (AFM) advised pilots to wait for ice to build before inflating the pneumatic deice boots.

Training and guidance lag

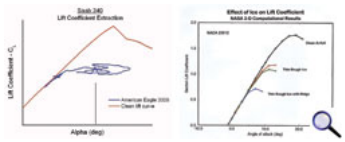
There has been extensive research and analysis of icing accidents in the past 14 years. However, the corrective actions have been slow in coming, and the word hasn't reached the flying community sufficiently.

In 1996, for example, FAA conducted icing evaluations of the Citation 560. These resulted in modifications to the stall warning system to increase stick shaker speed in icing conditions, but did not change the procedures for pneumatic deice boot operation.

In 1997, based on its accident investigation of the crash of an Embraer Brasilia turboprop near Monroe MI, NTSB recommended that "leading edge deicing boots should be activated as soon as the airplane enters icing conditions because ice bridging is not a concern."

The same year, a government and industry workshop reported that there was no substantiation of the phenomenon of ice bridging. Then, in 1999, FAA proposed airworthiness directives on 17 airplane models-including the Citation 500, 501, 550, 551 and 560-that would have required manufacturers to change the AFMs so that pilots would be required to inflate deice boots as soon as ice accumulation began.

However, the directives were subsequently withdrawn based in part on earlier (1996) flight testing and resulting modifications to the Citation 560 stall warning system.



(L) Calculation of lift degradation during upset from FDR data for American Eagle 3008, which experienced a loss of control in icing conditions near San Louis Obispo CA (NTSB accident ref LAX06IA076). (R) NASA computational fluid dynamics (CFD) calculation of lift loss for several types of deice boot preactivation ice shape, obtained for the Comair 3272 investigation.

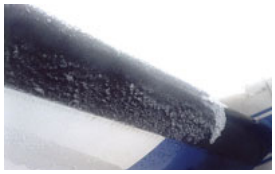
Instead, in 2002, FAA issued AC 91-74, which stated that there were few, if any, documented cases of ice bridging on modern deice boot designs. In Feb 2005, the board investigated an icing accident involving a Citation 560.

Review of the AFM again revealed guidance stating that the pneumatic deice boots should be activated when ice is 1/4-1/2 inch thick. In Dec 2006, FAA released a report stating that test

results supported "activation of lifting surfaces' deicers at the first detection of ice formation on the aircraft's lifting surfaces and for the operation of pneumatic deicers in an automatic cycling mode."

A recent FAA Notice of Proposed Rulemaking (NPRM) covers all new transport category airplanes that will be certified for flight in icing conditions to (a) require activation of deice boots when they enter conditions conducive to ice formation, (b) be equipped with an ice detection system that will automatically activate the ice protection system, or (c) be equipped with an alerting-type ice detection system combined with a definition of visual signs (accretion on a bolt, windshield wiper etc) to activate the ice protection system immediately.

NTSB investigators are frustrated because it has been more than 10 years since research and investigations established that ice bridging does not occur and does not affect safety of flight. FAA has not taken regulatory action for airplanes that currently contain references to delaying deice boot activation.



Supercooled Large Droplet (SLD) ice accretion obtained during NASA research flights. This accretion can extend beyond the deice boot extent on both top and bottom, and can quickly destroy lift and/or climb rates.

Cessna engineers advised NTSB recently that they no longer believe that ice bridging is an issue and that they have removed the ice bridging statement from the AFMs. Yet many AFMs still advise pilots to wait until the ice thickness is 1/4-1/2 inch before activating the deice boots.

Investigators are also frustrated that ice detectors are not required equipment in every airplane currently certified for flight into known icing. Many airplanes still require pilots to identify ice on the wings visually (which can be difficult from the cockpit due to its location).

Further, many pneumatic deice boot systems only provide a means to cycle the system manually and have no provision for continuous operation. Although the NPRM will require ice detectors, automatic deice boot cycling and improved operational procedures for new airplanes, NTSB is concerned that airplanes currently flying will not be modified to this new standard.

Deice boot activation

NTSB would like to see all pilots activate the deice boots at the first sign of ice on any part of the airplane, even though early activation of the deice boots may be in direct conflict with guidance provided in some approved operating manuals.

If a pilot finds himself in such a dilemma, he can improve his safety margin by understanding the potential increase in stall speed with less than 1/4 inch of leading-edge ice and carefully maintain adequate airspeeds while adhering to the approved guidance.

The full NTSB report-identification number NYC07LA081-can be found at ntsb.gov.

Todd Gunther is an NTSB air safety investigator. Formerly a Bombardier CRJ700 captain with Comair, he has over 14,000 hrs TT in 55 models of aircraft.