

Breaking the Ice



Ice buildup on the wings of aircraft is a serious problem, a potential trouble source that can cause accidents or damage to the airplane. Which is why the military services, airline operators, aircraft manufacturers and public safety agencies are expressing great interest in a new NASA development, a deicing system that not only promises improvement in flight safety but offers bonuses in airplane performance and economics.

The system is known as the Electro-Expulsive Separation System (EESS) and it won for its inventor, Ames Research Center senior engineer Leonard A. Haslim, the 1988 NASA Inventor of the Year Award.

EESS uses only one thousandth the power of existing electro-thermal deicers and weighs a tenth as much. It can be used on helicopter rotors and jet engine inlet ducts as well as aircraft wings; it can be installed on new aircraft or retrofitted to aircraft already in service.

EESS is now commercially available. In November 1988, following a series of successful evaluation tests, including wind tunnel and flight testing at Lewis Research Center, NASA awarded a patent license to Dataproducts New England, Inc. (DNE), Wallingford, Connecticut. This first license grants DNE exclusive rights to market EESS for large turbine-powered airplanes and helicopters. NASA may award other licenses for small turbine-powered aircraft and for large and small propeller-driven aircraft. DNE has initiated a joint venture with American Airlines to study the specifics of an EESS for the airline's entire fleet; they are joined by McDonnell Douglas Aircraft Corporation in an examination of EESS installation in the company's airliners.

EESS consists of an elastic, rubberlike deicer boot on the wing leading edge, with flexible conducting copper ribbons embedded in the boot. The conductors are separated by slits in between and parallel to the ribbons. When the system is switched on, a bank of capacitors in the power supply discharges into the conductors. The strong direct current pulse, discharged in less than a millisecond, suddenly induces the conductor pairs to repel one another. The result is a violent and powerful force that causes the slit-voids to expand explosively; ice on the wing is instantly pulverized and ejected.

***A supereffective ice
removal system for use
on aircraft, ships or
bridges tops a selection of
spinoffs in public safety***

This technique overcomes many of the limitations of other deicers. For example, jet transport aircraft generally use systems that bleed hot air from the engines to melt wing ice, but the bleed reduces engine thrust and increases fuel consumption; use of EESS costs no penalty in performance or economics. Pneumatic deicing boots operate slowly and will not break ice until it becomes one-quarter to one-half inch thick; when it does, big chunks may damage engines or airfoils. EESS has demonstrated ability to eject ice of any thickness from mere frost to an inch-thick glaze; it does so instantly and pulverizes the ice so that no shard is large enough to damage the plane.

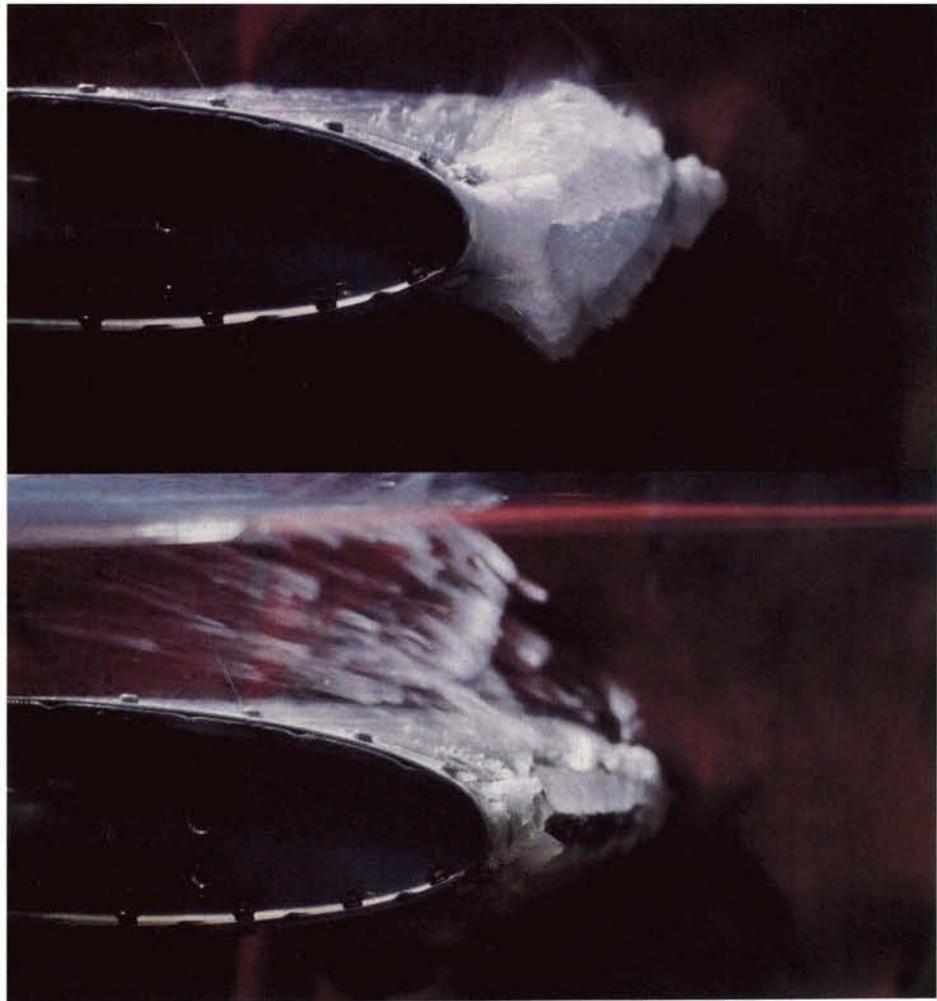
EESS offers similar advantages over all existing systems; generally it is more flexible, more effective in cracking and ejecting ice, smaller in both weight and space requirements, easier to maintain and repairable in the field.

Although EESS was developed as an aircraft system, it has other important applicability — for instance, in the problem of ship icing. Shipbuilders and ship operators are interested in an effective way to remove ice from ship superstructures. A big ship like a guided missile cruiser can accumulate very large ice accretions that could impact performance. Ingalls Shipbuilding, builder of U.S. Navy Ships, is participating in development and test of a shipboard EESS. Westinghouse Electric Corporation is developing a ship deicing system and DNE is also investing ship applications.

A ship deicing system would be a major boon to the nation's fishing fleets, such as those operating off the coast of Alaska, where harsh icing conditions are a potential hazard. Ames Research Center is working with the Alaskan Department of Commerce and Economic Development to explore the possibilities of installing a maritime EESS on Alaskan fishing vessels.

EESS also shows promise for bridge deicing. Bridge icing is a hazard to drivers and a dangerous, costly threat to the bridge's structure because chemical removal of the ice layer can cause structural and surface damage. The Federal Highway Administration has enlisted NASA's aid toward solution of the problem.

And it doesn't stop there. Haslim sees applications of the electro-expulsive concept in industry, for example in the bakery and plastics industries as part of a mold release mechanism to speed up production lines. And it might even be applied to a synthetic self-pumping artery for heart patients. Haslim is working with a Stanford University medical engineer on that application. Although the research will take many years, he thinks "We can make it happen.



These sequential photos show a wind tunnel test of an innovative Electro-Expulsive Separation System (EESS) on an ice-covered aircraft wing segment. In the top photo, EESS has just been activated; in the middle photo, taken less than a millisecond later, most of the ice is gone, pulverized and ejected by an EESS-created electromagnetic force. In the lower photo is Ames Research Center senior engineer Leonard A. Haslim who won the Inventor of the Year Award for developing EESS, which offers a wide range of advantages over existing aircraft deicing systems.