NASA News

National Aeronautics and
Space Administration

Washington D C 20546
AC 202 755-8370

For Release

IMMEDIATE

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RELEASE NO: 81-[redacted] 38

NASA LEWIS WORKING ON DE-ICING FOR SMALL PLANES, COPTERS

Some three decades ago, NASA helped solve the inflight icing problem for large air transports. Now NASA's Lewis Research Center, Cleveland, has initiated a new assault on one of the last frontiers of all-weather aviation: icing protection for small aircraft and helicopters.

The reasons: The growingly sophisticated general aviation sector with 200,000 planes and some 800,000 private pilots, is being impeded in its operations or, at times, experiencing catastrophe because of icing; despite the fact that many of its most crucial missions take it into potential icing environments, no U.S.-built helicopter is certified to fly into predicted icing conditions.

(NASA-News-Release-81-38) NASA LEWIS WORKING ON DE-ICING FOR SMALL PLANES, COPTERS (National Aeronautics and Space Administration) 5 p

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March 16, 1981

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Guiding the new program at Lewis is the recently-formed Safety Technology Section headed by John J. Reinmann. It operates as part of the center's Low Speed Aerodynamic Branch under chief Roger Luidens.

"Our Icing Research Tunnel," says Reinmann, "with its 1.8 by 2.7 meters (6 by 9 feet) test section, is the largest refrigerated wind tunnel in North America. Within it we can duplicate precise inflight icing conditions, study factors that cause icing, and test proposed anti-icing and de-icing systems."

The goal of the Lewis effort is to increase the effectiveness of existing ice protection systems and, concurrently, develop advanced concepts for both anti-icing and de-icing systems that will be reliable, cost-effective, energy efficient, light in weight and easy to maintain.

Icing occurs almost exclusively between ground level and 6,100 m (20,000 ft.). To fly through predicted icing conditions, an airplane must legally be certified to do so by the Federal Aviation Administration. Such certification is earned by having approved ice protection systems on board, and pilots flying into these predicted icing conditions without certification do so illegally.

Today's certified planes employ one or more ice protection systems including, most popularly, pneumatic rubber boots fitted to the leading edges of the wings and tails.

They are inflated with air after initial ice formation and serve to break up accumulated ice.

Other popular schemes include: routing hot air from the engine to selected aircraft areas where ice builds up; protecting the propellers by electrically-heated boots secured to the blades' leading edges; and releasing liquid antifreeze from the root of the propeller blades.

The growth of the versatile helicopter during the past 35 years has been meteoric and its applications are more versatile today than any other type aircraft.

The helicopter is widely used in business and industry, the military, law enforcement and traffic control, air-sea and wilderness rescue, civilian transport, freight hauling of all kinds, construction, agriculture and in scores of other ways.

Virtually all of a helicopter's missions are carried out well within altitudes where icing occurs. Moreover, its limited fuel capacity restricts its range and its ability to take evasive action from an icing enviroment.

While all of the vital parts of a helicopter are subject to ice accretion, its rotor blades are most sensitive. The rotor system is a complex, rugged, yet carefully balanced mechanism. Removing ice from the rotor during flight is a difficult undertaking for ice must be removed in a symmetrical fashion so as not to throw the blades out of balance.

Numerous solutions to the icing problem are now under study by the NASA Lewis ice team. They include:

- The Ice Phobic: Aviation engineers have long sought an "ice phobic," an agent that has an aversion to ice in much the same way that Teflon and silicones repel various substances.

"Without doubt," says Reinmann, "the ideal anti-icing agent is the 'ice phobic,' one that could be permanently applied to critical surfaces, adding little weight, being low in cost, and never needing replacement.

"The search for that miracle," continues Reinmann, "is a high-risk venture with a high pay-off potential and it is well up on the list of alternatives we are studying."

- Electro-Thermal: One method that is currently in use by both planes and helicopters is electrically generated heat. This is now felt to be the most developed of all ice protection ideas under consideration for helicopters.

In use, a network of wires is imbedded in the leading edges of the rotor blades. The system produces sufficient heat to release ice. But to create enough heat to raise blade surface temperature to 40 degrees F requires the output of 25 watts of electricity per square inch of blade surface. That requires a generator equal to the weight of one passenger in a five-passenger helicopter, reducing payload by 20 percent.

● Pneumatic boots: Boots are in wide use but their effectiveness is limited. They don't always remove all the ice and they do not, of course, affect ice that has built up aft of the boots. Introduced 40 years ago, the boot has undergone a number of design improvements.

There are numerous other ice protection system possibilities such as mechanical vibrators, oscillators, microwaves and electromagnetic impact, all of which are included in the Lewis program. Attacking icing is -- like all problems involving natural phenomenon -- a complex venture. It involves meteorology, aviation science and engineering, chemistry, metallurgy, physics, and other fields of study.

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