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NASA's contribution to fracture toughness testing represents a broad area of spinoff. NASA-Lewis procedures have been used in testing a variety of structures and systems, ranging from nuclear reactors and power generating equipment to tractors and plows. In addition to bridge safety, another transportation-related example involves production of snowmobiles. Deere & Co., Moline, Ill., used the NASA technology as a basis for selecting better aluminum alloys and improving quality control procedures to reduce the chance of failure in high-speed rotary components of snowmobiles.

### Log Truck-Weighing System

ELDEC Corp., Lynwood, Wash., built a weight-recording system for logging trucks based on electronic technology the company acquired as a subcontractor on space programs such as Apollo and the Saturn launch vehicle. ELDEC employed its space-derived expertise to develop a computerized weight-and-balance system for Lockheed's TriStar jetliner.

*This snowmobile benefited from NASA fracture toughness procedures. The manufacturer—Deere and Company—used the NASA technology to select better metals and reduce chances of failure in high-speed rotary components.*

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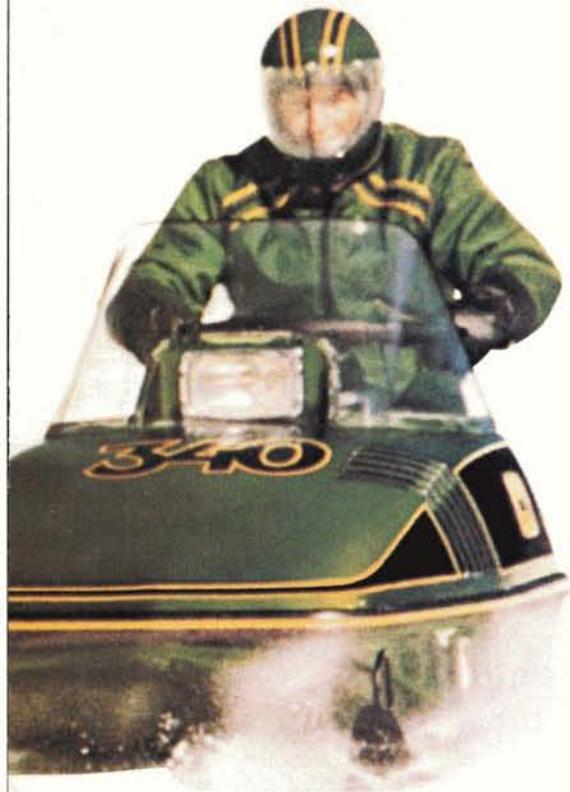
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*NASA aircraft-icing research data resulted in design modifications to the Sikorsky S-64 Skycrane, expanding the helicopter's utility.*

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ELDEC then adapted the airliner system to a similar product for logging trucks. Electronic equipment computes tractor weight, trailer weight and overall gross weight, and this information is presented to the driver by an instrument in the cab. The system costs \$2,000 but it pays for itself in a single year. It allows operators to use a truck's hauling capacity more efficiently since the load can be maximized without exceeding legal weight limits for highway travel. Approximately 2,000 logging trucks now use the system.

### Iceproofing Helicopters

NASA aircraft-icing research has been applied to expand the utility of the big flying-crane helicopter built by the Sikorsky Aircraft Division of United Technologies in Stratford, Conn. Sikorsky wanted to adapt the Skycrane, used in both military and commercial service, to lift heavy external loads in areas where icing conditions occur; ice build-up around the engine air inlets caused the major problem.

NASA-Lewis has a special wind tunnel for injecting super cooled water droplets into the wind thereby simulating a natural icing cloud and observing how ice builds up on various shaped surfaces. From Lewis, Sikorsky engineers obtained information which optimized the design of the inlet anti-ice system. The resulting design proved to be an effective anti-icing modification for the flying crane. Sikorsky is also using additional Lewis Icing Research Tunnel data in its development of a new VTOL (Vertical Take-Off and Landing) aircraft.

*NASA-sponsored technology, acquired in the Apollo program, was adapted by a contractor to measure the weight of logging trucks. An instrument in the truck cab displays electronically-computed weight data, enabling truck operators to improve earnings by maximizing loads without exceeding legal highway weight limits.*

