NIAR Tops Aero R&D
World-class facility is at the center of work on composites and aging aircraft

EDWARD H. PHILLIPS/WICHITA, KAN.

The National Institute for Aviation Research is expanding its role as a global player in research and development for the aviation industry by establishing new laboratories and programs aimed at testing and certifying advanced technologies related to safety and airworthiness.

John S. Tomblin, executive director, says the National Institute for Aviation Research (NIAR) provides the global aerospace industry with a facility and personnel specializing in research, certification testing, transfer of technology and training. Founded in 1984, the institute is the largest stand-alone university aerospace R&D laboratory in the U.S. and operates three FAA-designated Centers of Excellence, including the Center for Excellence for Composites and Advanced Materials. In addition, NASA has designated NIAR as the National Center for Advanced Materials Performance.

Tomblin said the organization has a staff of more than 220 people, with a majority holding doctorates, masters and bachelors degrees. The current facility—at Wichita State University—houses 15 laboratories, with plans underway to build an icing tunnel scheduled to become operational in 2007. Funding comes chiefly from the FAA, NASA, the Defense Dept. and industry, according to Tomblin.

He said a key function of NIAR is to act as a “non-biased link” between original equipment manufacturers (OEMs) and the FAA. The institute has performed a myriad of research, testing and certification work for a plethora of OEMs, including Boeing, Cessna Aircraft Co. and Dassault Aviation.

NIAR recently established and opened the Advanced Joining Laboratory dedicated to exploring new joining technologies. A key focus of the laboratory is on friction-stir-welding (FSW) technology designed to replace the use of rivets on airframe structures.

In the U.S., FSW is being proposed by Eclipse Aviation to manufacture its Eclipse 500 very-light jet. The chief aim of the research is to determine “design parameters and allowable for FSW joints that can be used by the aviation industry in general,” Tomblin said. The 3,930-sq. ft. laboratory began operating last month and features a five-axis FSW machine with a 120 X 25 X 40-in. work envelope.

“The FSW process could potentially provide significant improvement in the structural integrity and damage tolerance of metallic aircraft structures” because it eliminates holes drilled for rivets that are a major source of cracks, said Dale Cope, director of the laboratory. He said the new laboratory will equip NIAR to achieve further advancements for the use of FSW in the aerospace industry.

Another major research thrust at NIAR is the effect of composite structures on aging aircraft. A 30-month program is underway that uses a Beechcraft Starship composite airframe. Tomblin said the program will provide researchers with a better comprehension of the aging process of composite structures and promote understanding of the residual fatigue life of a composite wing years after its manufacture.

Plans call for investigating a number of key areas, including changes in mechanical properties using coupon and element testing; degradation in physical properties and resin chemistry; the effectiveness of repairs; and effects of heat, humidity and ultraviolet radiation, as well as failures around holes and fasteners. At the end of the program, the FAA will use the results to assess the effectiveness of existing nondestructive testing equipment and procedures used to detect flaws in the materials.

“It is imperative that as an industry we understand the effects of aging, both calendar- and flight-hour-related, on composites prior to a structural failure,” said Melinda Laubach, manager of the Aging Aircraft Laboratory. In addition to the Starship initiative, the laboratory is investigating the effects of aging on a decommissioned horizontal stabilizer from a Boeing 737-200. Along with conventional nondestructive inspection methods, Laubach said the laboratory will use advanced techniques such as 3D photogrammetry and laser holography to evaluate changes in thermal, chemical and mechanical properties.

In January, NIAR completed upgrading of its Crash Dynamics Laboratory featuring an MTS Systems accelerometer sled, more office and work space, a new photographic lighting system and a digital, high-speed video system that captures 1,000 frames per sec. The 4,500-sq.-ft. facility will be used by the aviation and automotive industries to test advanced crashworthiness concepts. According to Tomblin, the servo-hydraulic sled can attain speeds up to 50 mph with a 3,300-lb. payload and can be adjusted to pulse peak profiles that match a customer’s needs up to 65g (75g with a 2,200-lb. payload).

In addition to the laboratories, NIAR is home to the Walter H. Beech Wind Tunnel. Built 50 years ago, the tunnel has recently undergone a $6-million upgrade that includes a new, six-component external balance; flow conditioning equipment; a 500-hp. fan capable of maintaining speeds greater than 200 mph. In the new, larger test section; and 51 pressure ports.