Miniature Test Cell Helps Students Learn About Jet Engines

MICHAEL O. LAVITT/NEW YORK

A family-owned Wisconsin company has developed a miniature test cell with a 40-lb.-thrust turbine engine so engineering students can apply the theory they learn in the classroom to an actual jet engine.

The heart of Turbine Technologies Ltd.'s Mini Lab is an SR-30 turbojet engine, also made by the small company. The SR-30 was developed for drones or unmanned aerial vehicles several years ago but only flew for the first time recently, the company president, Wolfgang Kutrieb, said.

The engine weighs less than 10 lb., measures 6.75 in. in diameter and is 10 in. long. It burns 7 lb. of kerosene per hr. while developing 40 lb. of static thrust. It features an axial turbine, a reverse flow annular combustor and a centrifugal compressor. The turbine and nozzles are made from advanced nickel alloys using a vacuum investment casting process at the Turbine Technologies' facility.

Because the SR-30 features a recirculating oil system, it is not considered an expendable engine. Michael Kutrieb, the company's vice president and director of operations, said the first SR-30, which was sold to a Japanese customer, recently was returned for a teardown after achieving 1,000 hr. "It didn't need any new components," he said. "We are expecting to achieve over 2,000 hr."

The SR-30 has been sold to all three U.S. services, as well as in the Middle East and Japan, he said. Two U.S. universities and three in Japan are using the test cell.

Seniors majoring in aerospace engineering at the University of Alabama at Tuscaloosa and Embry-Riddle Aeronautical University in Daytona Beach, Fla., use the Mini Lab in required propulsion courses. Embry Riddle Prof. Lakshman Narayanaswami said in the six or seven months since receiving the Mini Lab, the engine has been run for 20 cycles of 10-15 min. each. The engine is run at an exhaust gas temperature of 700C (1,300F).

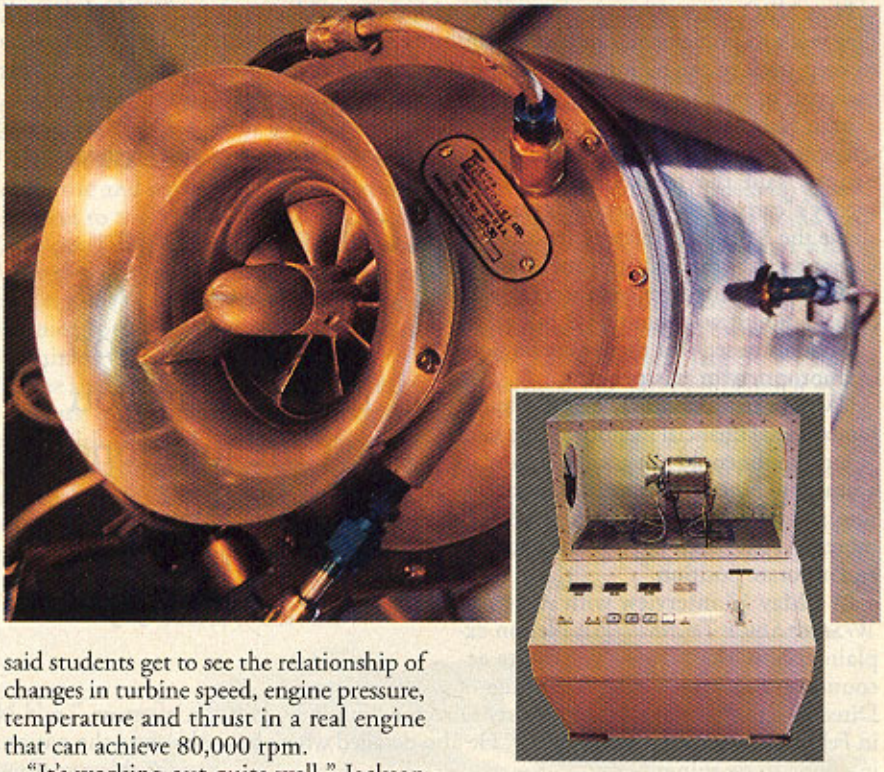
Prof. John Jackson, head of the Aerospace Engineering Dept. at Tuscaloosa, said students get to see the relationship of changes in turbine speed, engine pressure, temperature and thrust in a real engine that can achieve 80,000 rpm.

"It's working out quite well," Jackson said. "It gives you a way to go down in the lab and see how the theory you learn in the classroom works. It's got all the parts. It's just as valuable for educational purposes as a big engine."

The engine starts at 12% N1 by injecting shop air at 100-140 psi. It can be started repeatedly with less than 1-min. cool-down periods.

The Mini Lab houses the SR-30 in a steel cabinet that is about 5 ft. long with polycarbonate windows. The engine's motor mount is linked to a strain gauge load cell that provides continuous thrust readouts. Fuel and oil tanks, as well as an oil cooler and filters, are housed in the lower part of the cabinet.

A throttle lever on the right side of the instrument panel allows smooth power changes between idle and maximum N1. The Mini Lab also features digital engine rpm. and exhaust gas temperature gauge, and mechanical engine pressure ratio, oil, fuel and air gauges. Annunciator lights warn of low oil pressure, ignitor on, excessive engine vibration and air start status.



The SR-30 turbojet engine, which is just 10 in. long and develops 40 lb. of static thrust, is the heart of Turbine Technologies' Mini Lab test chamber. The equipment is being used at several universities.

The Tuscaloosa college also is using the Mini Lab in Project Nova, a NASA-sponsored program for training prospective high school science teachers in the basics of aerospace engineering. Lessons learned from the program are being shared with 40 other colleges around the nation in hopes of improving science education at the secondary level, Jackson said.

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