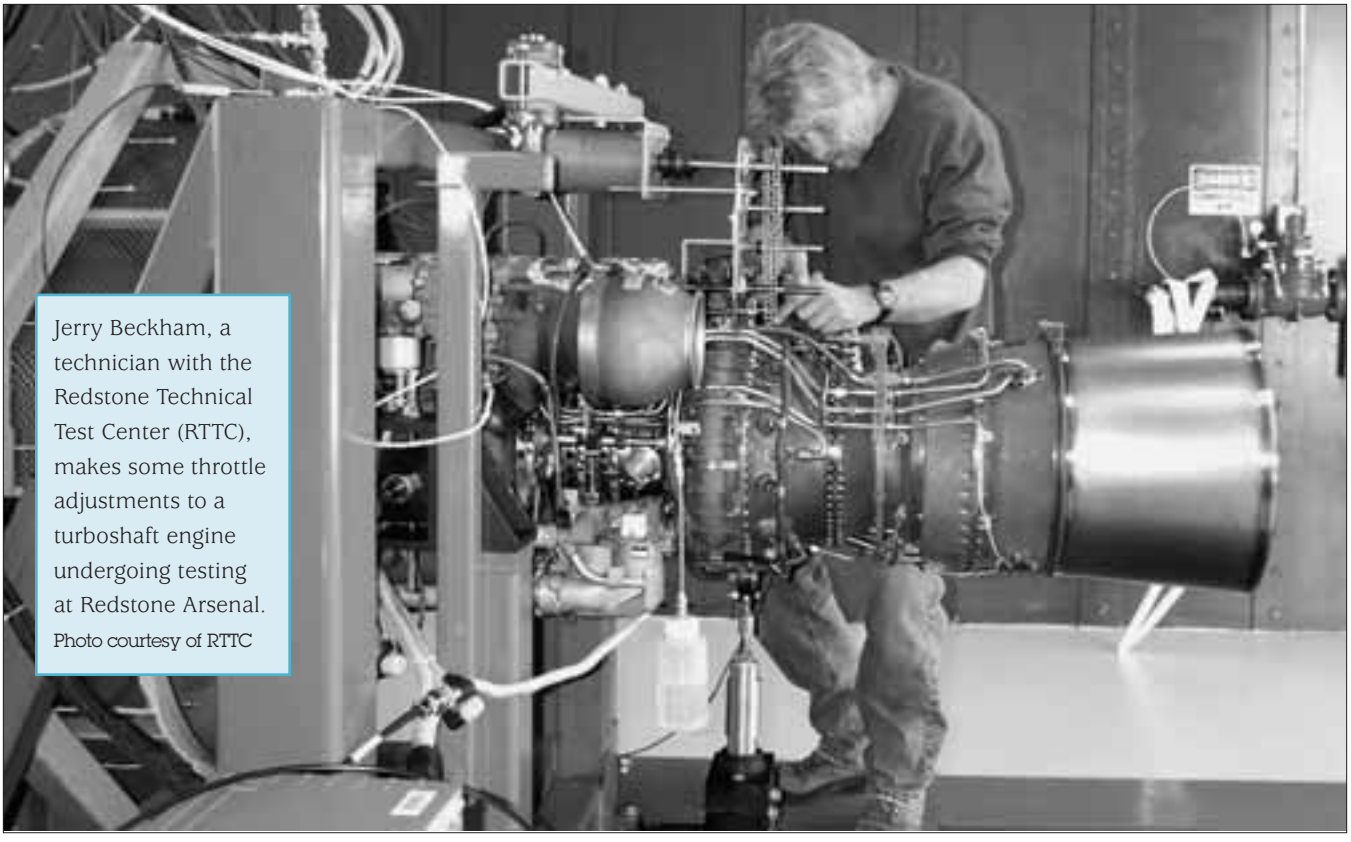
Pushing Performance

Redstone Arsenal Test Lab Helps Army Evaluate Turboshaft Aircraft Engines

Michael Cast



Jerry Beckham, a technician with the Redstone Technical Test Center (RTTC), makes some throttle adjustments to a turboshaft engine undergoing testing at Redstone Arsenal. Photo courtesy of RTTC

The high-pitched whine of turboshaft helicopter engines is figuratively music to the ears of Army testers at Redstone Arsenal in Alabama because it is the sweet sound of success for a multi-year team effort.

In early August 2002, the Redstone Aviation Propulsion Test and Research Facility (RAPTR), officially opened. RAPTR is a state-of-the-art facility designed to test helicopter turboshaft engines and their components, reducing the need to test aircraft in flight and so saving money and time. It owes its existence to the Army's Integrated Material Management Center (IMMC), which provided funding for its construction, and to the Research, Development and Engineering Center (RDEC) and the Redstone Technical Test Center (RTTC), two key players in the research, development, test, and evaluation program that combined resources to make RAPTR operational.

Although technically assigned to RTTC and within the security boundaries of that center's Static Test Branch, RAPTR is really a joint operation between RTTC and RDEC's Aviation Engineering Directorate. RTTC, a technical test center of the Army's Developmental Test Command, provides facilities, mechanical and electrical support, and test engineering and operator support, while the Aviation Engineering Directorate (AED) provides design engineering, test engineering, and an engineering research staff capable of resolving performance and design issues that may arise during testing.

"This partnership between RTTC and AED has been very successful and has given our customer base added value

Cast *is a public affairs specialist with the U.S. Army Developmental Test Command. He has served the army for 22 years as a journalist and photographer, newspaper editor, speechwriter, and public affairs specialist.*

in turboshaft engine testing," says Doug Chapman, an RTTC test engineer involved with the program.

The facility enables testers to acquire a variety of data about the performance of turboshaft engines and their components. An engine under test pulls in ambient air to operate, and a dynamometer also uses intake air to put a load on the engine's main rotor shaft. RAPTR can generate up to 3,500 shaft horsepower and up to 800 foot/pounds of torque. It has a fully automatic control system that starts the engine and performs pre-determined operational cycles and power levels. The system can emulate engine horsepower and load "profiles" with the aid of software that controls the various engine test scenarios.

It is very important that the control system continuously monitor certain sensors and measurements during any test to prevent a catastrophic failure that could harm personnel, the facility, or engine hardware, Chapman notes. If "redline" events that cause concern for testers occur during a test, RAPTR is designed to stop the test automatically and allow testers to take precautionary measures before resuming. Much of the RAPTR instrumentation has pre-defined levels for safety, causing RAPTR to go into redline when those levels are exceeded. The RAPTR control software can automatically shut the engine down to idle and/or cut off the fuel supply within milliseconds. RAPTR is currently able to monitor and record up to 500 channels of instrument data—including speed, torque, temperature, pressure, airflow, and so on—for long periods of time, at a cost of less than $500 per test hour.

RAPTR operators are capable of installing, removing, and assembling and disassembling an engine on-site. Additionally, component alignment and bore-scope investigation are provided within the test cell.

The facility is a "best value alternative" for aircraft engine testing for several reasons, according to Chapman. It provides a low-cost, state-of-the-art test capability for engines and their components and allows for a timely and dedicated response to developmental and field problems, he points out. A hands-on facility, RAPTR helps train new engineers and gives confidence to a more experienced staff of design engineers. It has proved its role as a vital testing tool for Army Aviation and related organizations, and it provides an independent correlation standard not available with industry or contractor testing at their facilities, Chapman says.

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Looking Forward

Expanded instrumentation, specialized test capabilities, and expanded engine models are planned for the future. The future facility will have an engine test cell 2 that includes a separate self-contained additional test bay with heated fuel and lubrication, as well as expanded data channels and an expanded data acquisition and control system. Designs are currently under development, and some of the initial groundwork is being accomplished, Chapman says. The tentative startup date is the first quarter of fiscal year 2005. Electronic component testing capabilities for the future are defined, according to Chapman, and are waiting on funding. The tentative startup date is sometime in fiscal year 2005 or 2006.

Capabilities for a transmission test facility are being defined, and funding is being requested. RTTC is also planning to add a Rotor Spin-Pit to RAPTR, but Aviation Engineering has not placed requirements for this capability very high on the priority list. At the time this article was prepared, no planned startup dates had been determined for these projects. RTTC is also developing the capability to conduct hydraulic component testing at another facility within the test center.

"The Army has high expectations for aviation propulsion systems and propulsion technology in the objective force," said Paul Bogosian, deputy program executive officer for aviation, at the ribbon-cutting ceremony in 2002. "As we look at the systems we take forward—the Apache, Black Hawk and Chinook—what we do to deliver objective force capabilities is highly dependent on propulsion capabilities. A lot of what we determine, and the path ahead that we set for the Army when it comes to propulsion technology, will be pursued in this facility. That's very gratifying. This is a wonderful opportunity for all of us, and we're glad it's here."

Editor's note: The author welcomes questions and comments and can be contacted at michael.cast@dtc.army.mil. Cast acknowledges the *Redstone Rocket* Army newspaper for publishing statistics that led him to further research RAPTR.