



Aeropropulsion Systems Test Facility (ASTF)

The Aeropropulsion Systems Test Facility (ASTF) at the Air Force's Arnold Engineering Development Center, located at the Arnold Air Force Base in southern Middle Tennessee, is a unique national facility designed to test aircraft propulsion systems in true mission environments without leaving the ground. Identified by a joint National Aeronautics and Space Administration and Department of Defense Aeronautics and Astronautics Coordinating Board in the 1960s as essential to the nation, ASTF was designed for testing integrated, full-scale propulsion systems under simulated flight conditions that are more realistic than ever before. Construction began in 1977, took seven years to complete and involved as many as 1,000 workers. Following integration and activation, the facility reached initial operational capability in September 1985.

Facility Description

ASTF is part of AEDC's Engine Test Facility, which has established the center as the USAF center of expertise in turbine engine testing. Located on a 57-acre site, ASTF is an open-circuit facility with two test cells, each 28 feet in diameter and 85-feet long. For comparison, the next largest ETF test cell is 20 feet in diameter and 60-feet long.

The unique features of ASTF permit new types of data to be acquired in ground testing that was previously available only after extensive flight testing.

ASTF provides the United States with the unique test capability of simu-



Photo no 01-55503

ASTF Aerial

lating flight conditions at altitudes up to 100,000 feet, at speeds up to Mach 3.8, for engines rated up to 100,000 pounds of thrust.

The air supply compressors can provide up to 1,500 pounds of air per second (more than one-million standard cubic feet per minute) into the test cell to simulate airspeeds up to more than 2,000 miles per hour. The compressors, totaling 215,000 horsepower, are started by the largest variable frequency starting system in the world. An additional 1,400 pounds per second of airflow is available by drawing outside air directly into the test cell.

Providing properly conditioned air to the propulsion systems to simulate supersonic flight conditions calls into play the largest air heaters in the world. These heaters can burn either natural gas or waste aviation fuel and generate enough heat (one billion BTUs per hour) to raise the temperature of the airflow to a maximum of 1,020 degrees Fahrenheit (enough to

heat 2,200 average houses on a sub-zero windy day).

Exhaust gases can reach temperatures of nearly 3,500 degrees Fahrenheit and must be cooled before they go through the exhaust machinery and are vented into the atmosphere. Initial cooling is done by direct-contact water spray, which reduces the temperature to 2,500 degrees Fahrenheit. The exhaust then passes through a 4,600-pipe heat exchanger that reduces the temperature to 350 degrees Fahrenheit, and another water spray cools and cleans the exhaust gas to less than 180 degrees Fahrenheit before it enters the exhaust compressors. Cooling of the exhaust gases requires up to 200,000 gallons of water per minute. Total facility cooling water capability is 387,000 gallons per minute. Cooling towers are used to cool and recirculate a three-million gallon, closed-circuit reservoir of water that is used during testing operations.



Photo no 92-223206

The Pratt & Whitney 4084 is one of the largest turbine engine ever tested at AEDC. The engine stands ten feet in height, has a 112-inch diameter fan and a thrust capacity in the 73,000 to 90,000-pound range. It is one of the power plants used on the Boeing 777 jet liner.

WORKLOAD

Systems testing at the center include the F/A-22 Raptor Air Dominance Fighter and the F-35 Joint Strike Fighter. The Pratt & Whitney F119 power plant for the F/A-22 has been extensively tested in ASTF since 1989. The Pratt & Whitney F135 engine for the F-35 will be at AEDC for testing for the next several years. In addition to testing military planes, ASTF has been instrumental in making America more competitive in the international market. As part of a congressionally enacted law allowing U. S. government agencies and facilities to open their doors and technology to American industry, a contract was signed between the Air Force and Pratt & Whitney for development testing of the PW4000 series growth engine in ASTF to determine the new engine's operational characteristics and qualify it for flight. The PW4084 engine is one of the engines airlines can order to power the twin-engine Boeing 777 widebody jetliner. It is

nearly 10 feet in diameter. The first PW4084 test occurred in the fall of 1992. The Rolls-Royce Trent 800 engine that powers some of the Boeing 777 commercial aircraft was also tested at the center in support of Rolls-Royce's FAA certification of that engine.

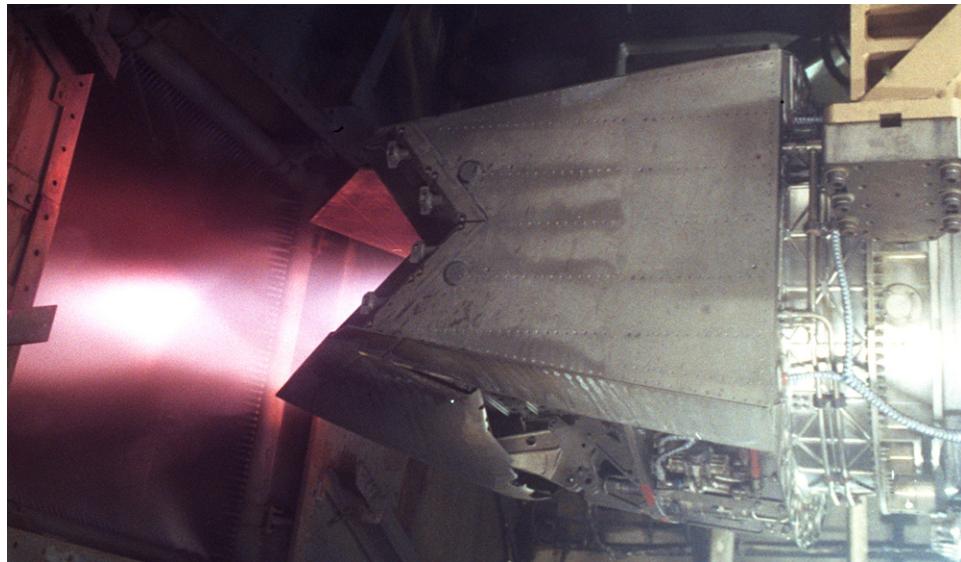


Photo no 96-177210

The Pratt & Whitney F119 engine for the F/A-22 Raptor running under simulated altitude conditions in ASTF.

AEDC BACKGROUND

Arnold Engineering Development Center is the nation's largest complex of flight simulation test facilities. The center was dedicated in June 1951 by President Harry Truman and named after 5-star General of the Air Force Henry 'Hap' Arnold, visionary leader of the Army Air Forces in World War II and the only airman to hold 5-Star rank. Today, this \$7.5 billion complex has some 58 aerospace test facilities located at Arnold Air Force Base, Tenn., and the center's remote operating location Hypervelocity Tunnel 9 in White Oak, Md. The test facilities simulate flight from subsonic to hypersonic speeds at altitudes from sea level to space. Virtually every high performance flight system in use by the Department of Defense today and all NASA manned spacecraft have been tested in AEDC's facilities. Today the center is testing the next generation of aircraft and space systems. For more information on AEDC visit the center's Web site at <http://www.arnold.af.mil/>



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