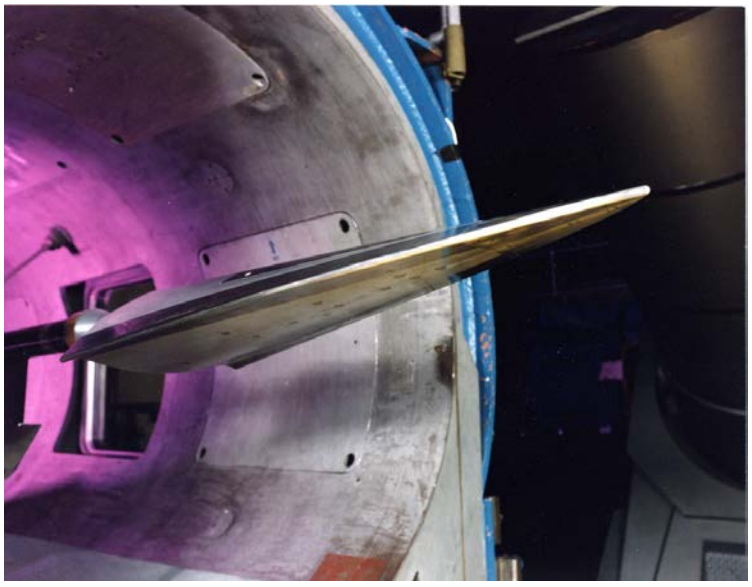
AEDC Hypervelocity Wind Tunnel No. 9 Tour

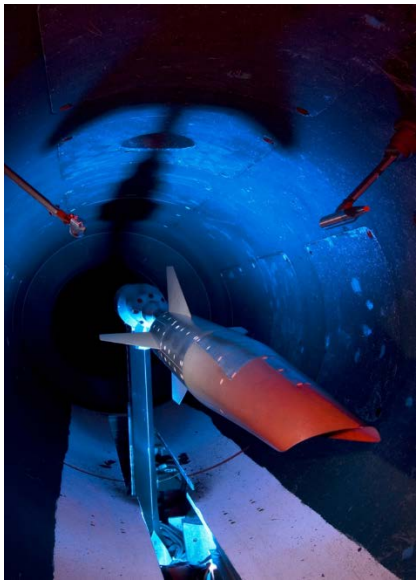
Join us on for a tour of the

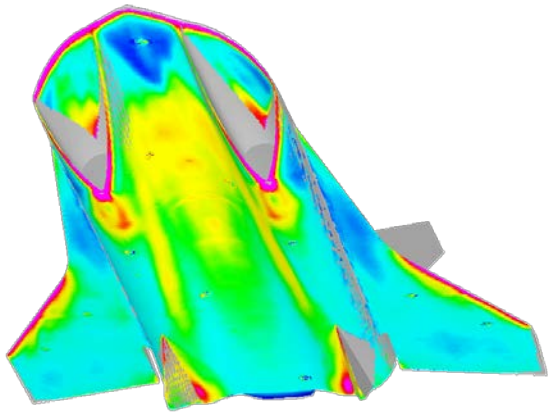
Arnold Engineering Development Complex/ White Oak Site

The Hypervelocity Wind Tunnel No. 9, (Tunnel 9) located at the White Oak, Maryland site of the Arnold Engineering Development Complex provides aerodynamic simulation critical to hypersonic system development and hypersonic vehicle technologies. The facility continues to supports testing for DOD, MDA, DARPA and NASA programs as well as advanced hypersonic technologies such as boost glide-type vehicles, scramjets, and trans-atmospheric space planes.

Tunnel 9 is the DoD's primary high Mach number and high Reynolds number facility for hypersonic ground testing and the validation of computational simulations. Noteworthy advantages over other facilities include a unique storage heater with pressures up to 1900 atmospheres and temperatures up to 3650 degrees Rankine. Axisymmetric contoured nozzles for Mach 7, 8, 10 and 14 (soon Mach 18) operation are available. When compared to other hypervelocity facilities which have run times of a few milliseconds, the long test times (seconds) available in Tunnel 9 provide higher productivity by allowing for parametric variation, e.g. an angle-of-attack sweep or flow survey, during a single run. The five foot (1.5 meters) diameter test cell accommodates large-scale test articles. The combination of operational range, long test times, and large test cell results in the highest Reynolds number, largest scale ground test facility in the world capable of simultaneously collecting continuous pitch polar static force and moment, pressure and heat transfer data during each test run. Having the ability to test at flight matched Reynolds numbers provides a significant risk reduction for the design and evaluation of hypersonic systems.







Hypersonic Waverider and Scramjet concepts; aerodynamic validation and verification testing

Contoured Nozzle	Reynolds # Range (million/ft)	Supply Pressure Range (psia)	Supply Temperature (ºF)	Usable Run Time Range (sec)	Comment
7	4.0 – 8.0	2,800 – 6,000	2,900	3.0 – 5.0	Thermostructural Test Capability - Flight duplication of P, T & Velocity
8	4.0 – 48	1,000 – 12,500	1,200	0.22 – 1.4	High Reynolds number, flight duplication of dynamic pressure, naturally turbulent boundary layers with pitch capability
10	0.5 – 20	300 – 14,000	1,350	0.23 – 5.0	High Reynolds number naturally turbulent boundary layers with pitch capability
14	0.055 – 3.6	100 – 19,000	2,700	0.7 – 30.0	High Reynolds number / High Mach number simulation with pitch capability
18*	0.25-1.5	2,500-15,000	3000	3-4	Med High Reynolds number / High Mach number simulation with pitch capability

*Future Capability: IOC planned during CY 2019

Tunnel 9 is useful for cost-effective environment for research and development test and evaluation (RDT&E) as well as investigating the complex physics associated with hypersonic science and technology. Past testing include aerodynamic, aerothermal, seeker window thermal-structural and aero-optic, shroud removal, hypersonic inlet, fundamental flow physics and CFD validation experiments.

Tunnel 9 is available to government agencies and commercial industry for unclassified or classified testing. Test models may be designed and constructed at Tunnel 9 or provided by the customer following consultation and planning with Tunnel 9 engineering staff. Instrumentation, assembly and installation is typically performed by Tunnel 9's professional staff.

Tunnel 9 is a remote location of the Arnold Engineering Development Complex (AEDC) which is located in southern Middle Tennessee. AEDC is the nation's largest aerospace ground test facility complex that includes 58 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges and other specialized test units. Twenty-seven of the test units have capabilities unmatched in the United States and 14 have capabilities unmatched in the world. Using its ground test facilities, AEDC supports propulsion, aerodynamic, reentry, trans-atmospheric and spaceflight systems testing.

Besides Tunnel 9 AEDC hypersonic capabilities span RDT&E needs from material evaluation, aerodynamic and aerothermodynamics to propulsion including scramjet and rocket testing as depicted in the figure below. Information on all other capabilities is available on www.arnold.af.mil or can be provided by anyone of the AEDC staff.

AEDC Hypersonic Ground Testing Infrastructure